Monetary Policy Regimes and Economic Performance: The Historical Record, 1979-2008*

Luca Benati
European Central Bank†

Charles Goodhart
Financial Markets Group
London School of Economics‡

Abstract

This chapter updates the Bordo and Schwartz chapter in Volume 1A of the *Handbook of Macroeconomics* to the period 1979-2008.

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†Monetary Policy Strategy Division, European Central Bank, Kaiserstrasse 29, D-60311, Frankfurt-am-Main, Germany. Email: Luca.Benati@ecb.int

‡Room R414, London School of Economics and Political Science, Houghton Street, London WC2A 2AE, United Kingdom. Email: caegoodhart@aol.com

> This is a time of testing—a testing not only of our capacity collectively to reach coherent and intelligent policies, but to stick with them. [...]
>
> – Some would suggest that we, as a nation, lack the discipline to cope with inflation. I simply do not accept that view.
>
> – Second, some would argue that inflation is so bound up with energy prices, sluggish productivity, regulation, and other deep-seated forces that monetary and fiscal policies are impotent. I do not accept that view.
>
> – Third, some would stipulate that we face impossible choices between prosperity and inflation. The simple facts of the past, in the United States and elsewhere, refute that view.
>
> —Paul Volcker (1979)

> Simply stated, the bright new financial system—for all its talented participants, for all its rich rewards—has failed the test of the market place.
>
> —Paul Volcker (2008)

1 Introduction

These years begin with a defining, climacteric event, the news conference held by Paul Volcker on Saturday, October 6, 1979, to announce the adoption of a new regime for monetary policy. Near the end of the thirty years covered in this Chapter, there is a second such defining moment, the collapse of wholesale interbank markets, on August 9, 2007. Had this Chapter been drafted prior to this latter date, it would have been markedly different in tone and content. The tone would have been one of acclaim for a steady trend of improvement in monetary policy analysis and outcomes, resulting in a NICE fifteen years of Non-Inflationary, Consistently Expansionary macroeconomic performance.[1] Moreover, despite earlier analytical concerns that the maintenance of stable inflation would require greater volatility in output, the experience of these later years was of a 'Great Moderation'[2] in the volatility of output growth and inflation, and to a lesser extent of interest rates (see Figure 1.1). Politicians claimed the end of boom and bust.[3] It seemed almost like the end of monetary history.[4]

[1] See King (2003).

[2] See Stock and Watson (2003).

[3] At the 2004 Labour party conference in Brighton, for example, the British Chancellor of the Exchequer, Gordon Brown, stated that '[n]o longer the boom-bust economy, Britain has had the lowest interest rates for forty years. And no longer the stop-go economy, Britain is now enjoying the longest period of sustained economic growth for 200 years.' (See Brown (2004).)

[4] See Fukuyama (1989) and Fukuyama (1992) for the original formulation of the notion of the end of history itself, in terms of the disappearance of all ideological rivals to liberal democracy.

[Figure 1.1]

Moreover, the substance of this paper has changed as well. In the *Handbook of Macroeconomics* (1999) the equivalent Chapter, written by Michael Bordo and Anna J. Schwartz,[5] had almost no mention at all of financial stability. And had we been writing in, say, 2006 our own draft, in all likelihood, would have given financial stability a very limited role. But history rarely runs a straight, much less a predetermined, course.

Whereas the various prior conditions, causes and the initial course of the current financial crisis have now, we believe, been quite clearly charted,[6] the, increasingly unconventional, response of central banks is still *in medias res*, and, of course, it is far too early to assess their efficacy. Meanwhile part of the blame for this debacle has been placed on a mistaken focus of financial regulation, with a call for the adoption of better designed macro-prudential instruments.[7] Most of these recent policy proposals, e.g. the Paulson Report,[8] have called for such extra responsibilities and instruments to be placed with the central bank, but this suggested allocation is far from universal.[9] So the ground is moving under the feet of today's central banks. Only time will tell where this process will lead.

Whereas the start and end of our main period, October 1979 to August 2007, are therefore clearly sign-posted by memorable events, the intervening 28 year period can, we suggest, be usefully divided into two sub-periods, the 'years of experimentation' (1979-1992), and the 'nice years' (1993-2006). Such a division, however, is much more arbitrary, being for example largely inapplicable to the dominant economy, the United States. In the U.S. the years of the 'non-borrowed reserve base' regime, from October 1979 to autumn 1982, stand out as special and *sui generis*. From then on, monetary policy there is run in much the same way until autumn 2007, though with increasing credibility, success and transparency as time passes. But for most of the rest of the world, apart from Germany and, perhaps, Japan, we would treat the first 13, or so, years as the age of experimentation with regimes:

- regimes relating to monetary policy, such as 'practical monetarism'; borrowed or non-borrowed reserve base; monetary base control; Inflation Targets; etc..
- Regimes relating to external monetary issues, such as pegged exchange rates, and the European Monetary System's Exchange Rate Mechanism.
- Regimes relating to financial regulation and supervision, such as the Concordat and Basel I.

[5] Bordo and Schwartz (1999).

[6] See for example Acharya and Richardson (2009), especially Chapter 1.

[7] See Brunnermeier, Crockett, Goodhart, Hellwig, Persaud, and Shin (2009).

[8] Paulson (2008).

[9] See e.g. the Turner Report (Turner (2009)).

Meanwhile in the political sphere there was continuing competition between Capitalism and Communism, between 'free markets' and state controls and direction for production and resources.

Then, at some ill-defined and arbitrary period, roughly around 1991-1992, it all came together, except in Japan: Communism collapsed, the Berlin Wall fell in November 1989, and Germany was reunited in October 1990. Free market principles had triumphed. With the partial exception of the United States, the primary objective of central banks became price stability[10] This was to be achieved *via* the adjustment of short term interest rates, directly targeting inflation, using a 'reaction function' along the lines of Taylor (1993), relating the central bank's policy rate to (expected) inflation and the (expected) output gap, and based on the 'Taylor principle' that nominal interest rates should be adjusted by more than one-for-one in response to changes in (expected) inflation.

Pegged, but adjustable, exchange rates had blown up too often.[11] Polarisation, in the shape of either currency boards/currency unions at one extreme, or free-floating at the other, came to be the proclaimed norm, though some of the self-described floats were closely 'managed'.[12] In particular, most of Europe (the Euro area) moved rapidly, following the Delors Report and the ERM collapse, to a single-currency, the Euro, adopted in January 1999, with the new currency successfully put in circulation in January 2002. This was a unique experiment, since there was now a single (federal) currency and monetary policy, whereas the member nation states maintained national control over (most) fiscal and other policies. Many outside, especially U.S., observers doubted whether this combination of policy and political competences would be sustainable,[13] but at least until the date of this writing it has proved successful.

The move towards operational central bank independence, buttressed by the general acceptance of the theories of the vertical Phillips curve[14] and of time inconsistency,[15] made them more powerful institutions. Combined with the increasing blurring of the marketing divisions between commercial banks, investment houses, securities institutions and insurance, this led—again with the partial exception of the U.S.—to a trend towards shifting bank regulation and supervision (including both prudential and conduct of business matters), away from the central banks to a single, separate, universal supervisor, a Financial Services Authority. Capital was to be

[10] We say 'with the partial exception of the United States' as the Federal Reserve's remit is 'to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates' (see Section 2a of the Federal Reserve Act).

[11] See e.g. the partial collapse of the European Monetary System's Exchange Rate Mechanism in 1992, with the exit of the United Kingdom and Italy, and the widening of the fluctuation bands *vis-à-vis* the Deutsche Mark for the remaining countries.

[12] [Put references here]

[13] See in particular Feldstein (1997a) and Feldstein (1997b). For an *ex post* assessment of the correctness of his original skepticism of the EMU project, see Feldstein (2009).

[14] Phelps (1968) and Friedman (1968).

[15] Kydland and Prescott (1977) and Barro and Gordon (1982).

made sufficient by a Capital Adequacy Requirement, based on Basel I and then Basel II, augmented in the U.S. by a leverage ratio, under the FDIC Improvement Act of 1991. Given sufficient capital, and efficient wholesale money markets, the concerns of earlier decades about (asset) liquidity and maturity mismatches simply became forgotten.

For some 15 years, or so (1992 to 2007), it all seemed to work perfectly, except in Japan. central banks focussed on their prime objective—price stability—and they succeeded without adverse consequences on other objectives of macro-policy (see Figures 1.2 and 1.3). Floating exchange rates remained considerably more volatile, either than desired or than could be explained by theory[16] (see Figure 1.4). But membership of the Euro area reduced the volatility of nominal effective exchange rates for member countries, and the U.S. and Japan were sufficiently large and closed to handle the outcome. Nevertheless Asia (1997/98) and Scandinavia (1989-92) suffered.[17] But what was the alternative?

[Figures 1.2, 1.3, 1.4]

In view of their success in establishing a much better macroeconomic environment than had been in evidence since the early 1960s, central bankers' profiles increased significantly. This was particularly so in the United States with Greenspan, but central bankers in many other countries—Tietmeyer and Poehl in Germany, Macfarlane in Australia, Trichet in France and then at the ECB, and King in the U.K.—all had high profiles.[18]

We shall structure our Chapter chronologically into three parts, covering 'The Years of Experimentation, 1979-1992', 'The Nice Years, 1992-2007' and 'The Financial Crisis, 2007-2009', respectively. In each of these parts we shall cover the main directions and results of macro-monetary policy, and their theoretical and academic background. We will then discuss the interactions between domestic monetary policies and international monetary developments. Finally we shall describe and report central bank policies with respect to their concern for maintaining orderly financial conditions as a pre-condition to the accomplishment of price stability.

Before delving into the main subject of this Chapter, however, we start by briefly discussing the key aspects and underlying causes of the Great Inflation of the 1970s, which will provide the background for the subsequent discussion.

2 Background: The Great Inflation Episode

The Great Inflation of the 1970s is a *historically unique* episode. Although history had previously witnessed several episodes of high inflation, or even hyperinflation, they had always systematically been associated with wars, civil wars, or revolutions,

[16] [Put references here]

[17] [Put Jonung reference]

[18] Because of the high quality of (most of) their Central Bankers, and the corresponding weakness of their political system, Central Bankers in Italy had long had such a high public profile there.

and with the resulting need, on the part of governments, to finance massive budget deficits *via* seignorage.[19] In contrast, as stressed e.g. by DeLong (1997) with reference to the United States, the Great Inflation is the *only* historical instance of a large, prolonged, and persistent inflationary episode during peacetime.

In this section we review key macroeconomic facts on the Great Inflation and we discuss several alternative explanations which have been offered in the literature. Our focus is on a comparison between the United States—which was the epicenter of the Bretton Woods regime under which the Great Inflation started—and Germany, which largely succeded in avoiding the Great Inflation.[20]

2.1 Key macroeconomic facts

2.1.1 Inflationary impulses

Fiscal policy During the second half of the 1960s, U.S. President Lyndon Johnson's determination to proceed with both the Vietnam war, and the spending programs associated with the 'Great Society', without a corresponding increase in taxation contributed to raise inflationary pressures across the board.[21] The cyclically adjusted budget deficit, net of interest payments, produced by the *Congressional Budget Office* (which is a simple measure of the extent of the fiscal stimulus imparted to the economy), oscillated between 0.1 and 0.3 per cent of potential GDP between 1962 and 1965, it rapidly increased to 1.6 per cent in 1966, and then reached a peak of 3.7 per cent in 1968, before decreasing during subsequent years. During the 1970s it oscillated between 0.4 and 1.8 per cent, thus pointing towards an overall stimulative fiscal policy stance during the entire Great Inflation period.

[**Figures 2.1 and 2.2**]

Food and energy prices Energy prices' role in igniting the U.S. Great Inflation in the second half of the 1960s appears, on the other hand, to have been essentially *nil*, with the rate of change of the energy component of the CPI oscillating between 0.0 and 3.7 per cent (see Figure 2.1). Food prices, however, appear to have contributed to a non-negligible extent to inflation's escalation. First, the 1965-66 inflation hump was preceded by a similar hump in food inflation, which reached a peak of 6.6 per cent in March 1966. Second, CPI inflation's subsequent hump, with a peak of 6.4 per cent in February 1970, was accompanied by a rapid acceleration in food inflation, which increased from -0.3 per cent in April 1967 to a peak of 7.8 per cent in February

[19] See e.g. Dornbusch and Fischer (1986).

[20] For an extensive discussion of how Germany successfuly 'opted out' of the Great Inflation, see Beyer, Gaspar, Gerberding, and Issing (2009).

[21] The notion that U.S. inflation's takeoff in the second half of the 1960s was partly due to the excessive pressure on resources created by the spending programs associated with the 'Great Society' is most notably associated with Fed Chairman Arthur Burns—see in particular several of the speeches collected in Burns (1978).

1970. For Germany (see Figure 2.2) the pattern of inflationary pressures during the second half of the 1960s appears to have been roughly the opposite of the United States, with stronger pressures coming from energy, and comparatively milder ones originating from food (with even several months of decrease in the food component of the CPI). During subsequent years food prices kept exerting strong inflationary pressures on the U.S. economy—especially in 1974, when food price inflation reached a peak beyond 20 per cent—but their impact was dwarfed by that of energy.

2.1.2 The role of the nominal exchange rate

A crucial difference between the United States and Germany during the Great Inflation episode is that, whereas Germany's nominal effective exchange rate (henceforth, NEER) kept strongly appreciating during most of the decade, the United States' significantly *depreciated*, with the result that, towards the end of the 1970s, the German NEER was about *twice* what it had been in January 1965, whereas the United States' was about 20 per cent lower. As a consequence, between the collapse of Bretton Woods and December 1979, the food and energy components of the U.S. CPI increased by 104 and 187 per cent, respectively, whereas the food and the electricity, gas, and fuel components of the German CPI increased by 42 and 108 per cent, respectively (see Figures 2.1 and 2.2). The crucial role played by the appreciation of the NEER in (partially) protecting the German economy from inflationary pressures originating on world commodity markets emerges especially claarly from a comparison between the increases in the 'electricity, gas, and fuel' component of the German CPI around the time of the first and of the second oil shocks. After abandoning the dollar peg, in March 1973, the German NEER appreciated swiftly, but then fluctuated comparatively little until 1976, which saw the beginning of a period of rapid appreciation which lasted until the end of 1979. The relative stability of the German NEER around the time of the first oil shock, and its rapid appreciation around the time of the second, explain why, whereas for the United States CPI energy inflation was higher in the latter episode than in the former, for Germany the *opposite* was true.

Given the endogeneity of nominal exchange rates, and in particular their link with monetary policy, the contrasting behaviour of the German and U.S. NEERs during the Great Inflation episode naturally shifts the focus of attention to differences between the monetary policy stances of the respective central banks.

2.1.3 The monetary policy stance

In the United States the trend component of the *ex post* real interest rate[22] had been positive, but comparatively low, during the period between January 1965 and

[22] See the third panel, top row, of Figure 2.1. High-frequency noise has been removed from the raw *ex post* real rate series *via* the Christiano and Fitzgerald (2003) band-pass filter (specifically, we removed all the components with a frequency of obscillation faster than six quarters).

the collapse of Bretton Woods, in August 1971, and it then turned systematically *negative* during the entire period between August 1971 and the beginning of the Volcker disinflation, in October 1979.[23] The fact that U.S. monetary policy stance had been so loose as to systematically produce negative real interest rates during the entire Great Inflation episode naturally suggests two considerations. *First*, it provides an explanation for the previously discussed depreciation of the U.S. NEER following the collapse of Bretton Woods: as Figure 2.1 shows, indeed, the peaks and troughs of the U.S. NEER during the 1970s match remarkably well the peaks and troughs of the filtered *ex post* real rate. *Second*, as stressed by Clarida, Gali, and Gertler (2000) in their influential analysis of the U.S. Great Inflation, the looseness of U.S. monetary policy during the 1970s strongly suggests that—in spite of the obvious inflationary impact of food, and especially oil price shocks during that decade—an excessively accommodative monetary policy played a crucial role in allowing U.S. inflation to take off and persist.

As for Germany, during the period leading up to the collapse of Bretton Woods *ex post* real interest rates had been systematically higher than their U.S. counterparts, thus highlighting the firmer stance adopted by the Bundesbank during those years. As extensively discussed by Issing (2005), following the first oil shock the Bundesbank tried to avoid second round effects largely

> '[...] by means of "moral suasion." However, the social partners more or less ignored the signals given by the Bundesbank and agreed on high increases in nominal wages in 1974 [...]. As a consequence, unemployment increased and inflation went up'.

Over subsequent years, the Bundesbank fully exploited the freedom of action it had gained when it was relieved of its obligation to defend the parity with the dollar, in March 1973, and it could therefore pursue a counter-inflationary policy which was appropriate for the conditions it was facing domestically, which generated systematically positive *ex post* real interest rates. This allowed it to bring inflation down to 2.1 per cent in September 1978, and to keep the subsequent inflationary peak, which followed the second oil shock, at 7.5 per cent in October 1981. As stressed by Issing (2005), in this respect the successful management of the impact of the second oil shock crucially hinged on the lessons learned from the failure of 'moral suasion' to rein in second-round round effects following the 1973 shock. Mindful of that experience, this time the Bundesbank adopted a significantly tougher policy stance.

2.1.4 The productivity slowdown

Developments in productivity growth provide a further, important perspective on the different macroeconomic performance of the United States and Germany during the

[23] The simple average of the U.S. *ex post* real rate was equal to 1.51 per cent during the period between January 1965 and August 1971, and to minus 0.90 per cent between the collapse of Bretton Woods and the beginning of the Volcker disinflation.

1970s. According to Orphanides' interpretation of the U.S. Great Inflation,[24] a crucial shortcoming of U.S. monetary policy during those years was its inability to detect the 1970s productivity slowdown in real time, which resulted in a systematic over-estimation of the true extent of slack existing in the economy. Given the extensive reliance, on the part of U.S. policymakers, on output gap measures as indicators of future inflationary pressures, such over-estimation automatically translated into the previously discussed excessively loose monetary policy. A comparison with Germany is, in this respect, intriguing. Between 1971 Q1 and 1979 Q4, the trend rate of growth[25] of German output per hour worked fell from 4.2 to 2.6 per cent. In spite of such decrease being significantly greater than the corresponding U.S. one—from 2.3 to 1.3 per cent over the same period—Germany's inflation performance was, as we previously pointed out, markedly superior to the United States'.

Following Orphanides' reasoning, there are two possible explanations for this. *First*, German policymakers were better at spotting the productivity slowdown in real time than their U.S. counterparts, which allowed them to correctly factor it into their policy decisions. *Second*, the Bundesbank's monetary policy framework, with its strong emphasis on price stability and, since December 1974, the explicit announcement of monetary targets, was conceptually different from the Federal Reserve's, and in particular less prone to being negatively affected by problems of output gap mismeasurement. Without a detailed knowledge of the Bundesbank's real-time perceptions of German productivity developments it is obviously impossible to discriminate between these two rival explanations. On the other hand, the notion that, for some reason, the Bundesbank might have been better at spotting the 1970s productivity slowdown in real time than their U.S. counterparts would appear, *ex ante*, as unlikely, which suggests that conceptual differences between the monetary policy frameworks of the two institutions probably played a decisive role.

2.2 Alternative explanations for the Great Inflation

The alternative explanations of the Great Inflation episode which have been suggested in the literature are usually classified into two broad groups, with the former attributing it to (a combination of) policy mistakes of various nature, and the latter pointing instead towards sheer 'bad luck', in the form of a sequence of large negative macroeconomic shocks.

2.2.1 Bad macroeconomic policies

On the 'bad policies' side, DeLong (1997) stressed the legacy of the Great Depression, and the deep scar it left on the national psyche, for the tendency, on the part of the

[24] See in particular Orphanides (2001) and Orphanides (2003).

[25] The trend growth rate in output per hour worked has been computed *via* the Christiano and Fitzgerald (2003) band-pass filter. Trend components have been defined as those with frequencies of oscillation longer than fifteen years.

U.S. government, to try to avoid shortfalls of economic activity at all costs, thus essentially imparting an inflationary bias to U.S. economic policy.[26] This position is echoed by Fed Chairman Martin's statement to the *Joint Economic Commitee* (henceforth, *JEC*) of the U.S. Congress in February 1968:[27]

> '[...] it is clear that we have, as a Nation, greater readiness to combat recession than to cope with inflation, despite the grave consequences that failure to restrain inflation could have for our economy, both domestically and internationally.'

The 1966 *Economic Report of the President* (henceforth, *ERP*) has a very similar position:[28]

> 'The desirability of price stability was clearly recognized in the legislative discussion of the Employment Act. But few considered the danger of postwar inflation nearly as great as the opposite danger of relapse into depression.'

A second theme stressed by De Long is the adoption, on the part of U.S. policymakers of the 1960s, of unrealistic and over-ambitious macroeconomic goals. In the 1962 *ERP*, in particular, John F. Kennedy set a 4 per cent target for the unemployment rate. That target was reiterated in the *ERP*s over subsequent years,[29] and it provided the basis for the computation of the level of potential GNP.[30] Between January 1948 and December 1961, however, the U.S. unemployment rate[31] had been above 4 per cent 66.6% of the times, which provides *prima facie* evidence that, most

[26] The notion of a structural inflationary bias in U.S. post-WWII macroeconomic policy—enshrined into law by the Employment Act of 1946—was eloquently expressed by future Fed Chairman Arthur Burns (see Burns (1957)), who called for an amendment to the Act stressing the fundamental goal of price stability. On this, see the discussion in Orphanides (2003, p. 634). The best-known formalisations of the notion of an inflationary bias which is *intrinsic* to discretionary monetary policy are those of Kydland and Prescott (1977) and Barro and Gordon (1983).

[27] See Martin (1968), page 12.

[28] See 1966 *ERP*, page 176.

[29] The 1965 *ERP*, for example, stated (on page 83) that 'the Council's estimate of potential GNP reflects the belief that the economy could operate at a 4 per cent unemployment rate today without substantial strains on either labor supply or plant capacity'. This target is found, once again, in the 1967 *ERP* (page 99: 'Under present conditions, an over-all unemployment rate close to 4 per cent appears to be associated with an approximate balance between supply and demand in most labor markets.'), whereas the 1969 *ERP* states that 'a 4 per cent unemployment rate was established as an "interim target" for national policy early in the Kennedy administration. In each of its last seven Annual Reports, the Council of Economic Advisers has based its estimates of potential output on a 4 per cent rate of unemployment. This Report continues to make use of this definition.'

[30] The 1969 ERP (page 64), for example, thus stated: 'In the last four Economic Reports, the Council has discussed the concept of potential GNP, defined as the volume of goods and services that the economy would ordinarily produce at the interim target unemployment rate of 4 per cent.'

[31] 'Civilian Unemployment Rate, U.S. Department of Labor: Bureau of Labor Statistics, Seasonally Adjusted, Monthly, Percent'.

likely, 4 per cent was not a realistic policy goal. Indeed, most econometric estimates of the natural rate for those years are well above 4 per cent.[32]

Orphanides[33] stressed that strongly activist monetary policy rules like those adopted in the 1960s and the 1970s, striving to keep the economy close to potential, suffer from a fundamental conceptual problem. Although such policies perform well under ideal conditions—i.e., under perfect knowledge, on the part of the policymaker, of (among other things) the value taken by the output gap at each point in time—given the inevitable uncertainties associated with estimating the output gap in real time, such policies may well produce markedly sub-optimal outcomes. According to Orphanides' explanation of the Great Inflation, a key problem was therefore lack of detection of the 1970s' productivity slowdown in real time, which led to a systematic over-estimation of the true extent of slack existing in the economy. Fed Chairman Martin, in his February 1965 testimony in front of the *JEC*[34], provides ammunition to Orphanides' point:

> 'There is, inevitably, an element of "brinkmanship" in our laudable efforts to push our economy closer and closer to its full potential without straining it.'

The key idea behind Clarida *et al.*'s (2000) interpretation of the Great Inflation is that, before October 1979, U.S. monetary policy had been so weakly counter-inflationary as to allow the economy to move inside what is technically called 'indeterminacy region'. The key feature of such a peculiar 'state of the economy' is that, since expectations are no longer firmly pinned down by policy, macroeconomic fluctuations no longer uniquely depend on fundamental shocks (technology, etc.), and, in line with Goodfriend's analysis of 'inflation scares',[35] may instead be influenced by non-fundamental elements. According to this view of the world, a central bank which is perceived by economic agents as not sufficiently strongly counter-inflationary injects volatility into the economy simply because it allows expectations to 'take a life of their own', thus causing large and persistent inflation fluctuations.

Romer and Romer (2002) blame the adoption, on the part of U.S. policymakers, of economic models featuring an exploitable trade-off between unemployment and inflation,[36] whereas Sargent (1999) proposes two alternative interpretations of the Great Inflation episode. In one of them (the so-called 'vindication' story) the Great Inflation and the subsequent Volcker stabilisation are the result of the Fed starting in the 1960s with the wrong model of the economy—i.e., believing in an exploitable

[32] Staiger, Stock, and Watson (1997), for example, estimate the natural rate to have been around 7 per cent in 1961, to have declined to about 5 per cent around mid-1960s, and to have then increased in subsequent years, reaching 7 per cent at the end of the 1970s.

[33] See in particular Orphanides (2002, 2003).

[34] See Martin (1965).

[35] See Goodfriend (1993).

[36] Limited support for their position can be found in the *ERP*. The 1967 *ERP* (p. 99), for example, rhetorically asks: 'If there is a trade-off between lower unemployment and price stability, how do we choose between them?'

trade-off between unemployment and inflation—and subsequently learning the truth via econometric methods.

Finally, Barro (1982) interprets the inflationary upsurge of the second half of the 1960s as the last—and decisive—move in a decades-long drift away from metallic standards, and towards a pure *fiat* currency regime:

> 'In earlier periods before roughly 1965, the monetary regime guaranteed some long-run stability in monetary growth, and therefore in long-term inflation, which in turn restricted the effects of shifting inflationary expectations [...]. The international economy has been moving gradually away from this type of monetary setup since World War I, and especially since the 1930s, although some remnants of the Gold Standard and fixed exchange rates in the form of the post-WWII Bretton Woods arrangements were in operation as recently as 1971. [...] Although there were earlier periods when the United States did not adhere to a gold or silver standard, these episodes typically occurred in times of war and could reasonably be perceived as temporary. The period since 1971 seems to be the first time that we have completely severed, both currently and prospectively, the link between our money and a commodity base.'

2.2.2 Bad luck

The 'bad luck' explanation is mostly associated with the 'structural vector-autoregressive (henceforth, VAR) literature'. Several authors—most notably, Stock and Watson (2002), Primiceri (2005), Sims and Zha (2006), and Gambetti, Pappa, and Canova (2006)—have produced three types of evidence. *First*, large decreases in the volatilities of VAR residuals around the beginning of the 1980s, thus suggesting that the Great Inflation had just been due to a particularly unfortunate series of large negative shocks. *Second*, the estimated response of the economy to monetary policy shocks does not appear to have been, during the 1970s, very different from what it has been more recently, which is interpreted as suggesting that, historically, monetary policy shaped macroeconomic outcomes only to a limited extent. *Third*, results from 'counterfactual simulations', in which (say) the estimated policy stance associated with Fed Chairman Greenspan is 'imposed' upon the whole post-WWII era, show limited differences in terms of overall macroeconomic outcomes, thus suggesting, once again, that policy did not play much of a role in shaping post-WWII macroeconomic fluctuations.

2.3 Taking stock of the causes of the Great Inflation

There are several reasons why, overall, explanations of the Great Inflation ascribing it to misguided monetary policies appear as significantly more plausible than those attributing it to an adverse sequence of exogenous shocks.

First, as stressed by Issing (2005), an often overlooked fact in discussions about the Great Inflation—which focus, most of the times, just on the U.S. experience—is that neither Germany nor Switzerland experienced it (at least, to the extent that is was felt elsewhere). This fact, of course, is difficult to square with the 'bad luck' explanation. In particular, Issing (2005) stressed that a fundamental reason why the Bundesbank could spare Germany the Great Inflation was

> '[. . .] the high inflation aversion in the German public [. . .], i.e. the German 'stability culture' that had evolved over time after the Second World war.'

According to this view, the ultimate reason behind the diverging macroeconomic performances of the United States and Germany around the time of the Great Inflation lies in a fundamentally different *attitude towards inflation* on the part of the respective societies.[37]

Second, as stressed by Clarida *et. al.* (2000), the U.S. Great Inflation started around 1965, well *before* the food and oil price shocks of the 1970s, thus posing a fundamental logical problem to 'bad luck' explanations. In October 1973 (the date of the first oil shock), for example, U.S. CPI inflation was already running at 8.1 per cent, which suggests that the economy was already set on an instability path well before the oil shocks hit.

Third, a convincing case has been made that OPEC's dramatic oil price increases of 1973 and 1979 would only have been possible under the conditions of generalised expansion in global liquidity associated with the collapse of Bretton Woods. This position—associated, around the time of the Great Inflation, with Milton Friedman, Phillip Cagan, and Ronald McKinnon[38]—has recently been revived by Barsky and Kilian (2001), who argued that a significant portion of the commodities prices rises of the 1970s should correctly be characterised as the *endogenous* market response to the global monetary forces unleashed by the collapse of Bretton Woods.

Finally, as we will discuss below in our assessment of the causes of the Great Moderation, for strictly *technical* reasons the evidence produced by the structural VAR literature is weaker than it appears at first sight. To anticipate, (*i*) since VAR residuals are not structural in the sense of Lucas (1976)—but they are rather reduced-form by definition—a decrease in their volatilities can, in principle, (partly) be explained by better monetary policy; (*ii*) little change over time in estimated impulse-response functions to a monetary policy shock is, in principle, compatible with significant changes in the systematic component of monetary policy; and (*iii*) the reliability of policy counterfactuals based on estimated structural VARs is open to question, and it has never been demonstrated in any way. On the contrary, existing evidence on the reliability of SVAR-based policy counterfactuals points towards a

[37] A conceptually similar position has been expressed by Posen (1995) with respect to the ultimate determinants of central bank independence.

[38] See Friedman (1974), Cagan (1979), and McKinnon (1982). See also the discussion in Darby and Lothian (1983).

troubling inability, on the part of such counterfactuals, to correctly capture the impact on the economy of changes in the monetary (e.g., Taylor) rule within the underlying structural (DSGE) macroeconomic model.

3 The Years of Experimentation, 1979-1992

3.1 The Volcker regime change, 1979-1982

3.1.1 The United States

> Ladies and gentlemen, I know we have had somewhat unsettled and problem markets in recent days. I will tell you that the major purpose of this press conference is to show that I have not resigned—the way the early rumor had it yesterday—and I'm still alive—contrary to the latest rumor. We have been busy during the day with the Federal Reserve Board and the Federal Open Market Committee in developing a series of actions which is reflected in the release in front of you.
>
> —Paul Volcker[39]

By the end of 1979 U.S. monetary policy was in a state of incipient crisis. Inflation had worsened, and had become endemic, and the U.S. dollar was sinking, but it seemed doubtful whether the scale and extent of interest rate increases that might be necessary to reverse this downfall—and nobody knew what this might be—would, and could, be acceptable either to the FOMC or to Congress, if put forward in the standard fashion. This crisis called for a dramatic shift of policy, and, under the guidance of three main protagonists, Volcker, Reagan and Axilrod, it got just that.

Steve Axilrod (the Chief monetary adviser on the Staff to the Board) was the 'chief engineer' who designed the new 'non-borrowed reserve base' system, alongside Peter Sternlight who ran the monetary operations at the Federal Reserve bank of New York. Paul Volcker was the Board's Chairman who agreed and took responsibility for the new policy. Ronald Reagan was the President who gave the Fed and the policy sufficient time and independence to work, despite the enormous volatility in interest rates and monetary growth that then occurred, and the consequent severe recession.[40]

In one sense this policy was not entirely new. The German Bundesbank had for many years focussed on monetary growth as the medium and longer term driver of nominal incomes and inflation, a position influenced both by experience of hyper-inflations and by the influence of key people such as Ludwig Erhard and Helmut

[39] From the Transcript of the Press Conference by Paul A. Volcker, Chairman, Board of Governors of the Federal Reserve System, held in the Board Room, Federal Reserve Building, Washington, D.C., October 6, 1979, available via FRASER® at the St. Louis Fed website.

[40] See Axilrod (2009) and Volcker and Gyohten (1992).

Schlesinger,[41] and had adopted a specific monetary target since 1974. That said, they never embraced either monetary base control, or a $k\%$ rule; instead they used deviations of actual monetary growth from its target value (itself determined by sustainable output growth plus a feasible inflation target, plus an assumption about likely trends in velocity),[42] as first a trigger for analysis and thereafter a rationale for a strong, countervailing adjustment in interest rates.[43] As we discussed in Section 2, German monetary policy—different from other countries' policies—largely succeded in avoiding the Great Inflation.

[Figure 3.1]

As a result, the Bundesbank became much admired amongst central bankers. Before introducing the new policy regime, Volcker outlined and discussed his proposals with Emminger, the President of the Deutsche Bundesbank (Volcker and Gyohten, *op cit.*, p. 168). But the technical details of the new scheme were unique to the United States.[44] U..S commercial banks were required to hold [**?**] % of their assets in cash reserves against their sight deposits and a much lower percent [**?**] against their time deposits. Moreover they would also normally want to hold a small buffer of excess reserves, depending on interest relativities. If one starts with an objective for nominal incomes, like the Germans, based on sustainable output growth and desired, feasible inflation, one can then, using demand-for-money functions work back to an estimate for the compatible monetary aggregates, e.g. cash in the hands of the public, M1 sight deposits, and M2 time deposits. From that, using the required ratios and an estimate for desired excess balances, one can work back to the total reserves banks would want, if nominal incomes/output grew as planned and interest rates remained unchanged.

banks obtained their desired reserves in two ways. First, there were the cash reserves that the Fed made available to them in the normal course of their (open market) operations, the non-borrowed reserve base. If this was insufficient to meet their requirements (and any residual demand for excess reserves, itself a function of interest relativities), banks in aggregate would have to borrow from the discount window. However, not only was the discount rate at a margin over the Fed Funds rate, but there were also some, fairly strong, non-pecuniary disincentives against borrowing from the window. So, as the need to borrow more (less) rose, market interest rates would rise (fall) steeply, as banks adjusted to the pressure to go to the window.

The chain of causation was thus supposed to run as follows:

1. deviation of money incomes/inflation from target $\rightarrow$
2. deviation of monetary growth from target $\rightarrow$
3. deviation of (required) reserves from non-borrowed reserves, plus desired bor-

[41] [Put reference: See Schlesinger 2002]

[42] See Bockelmann (1996).

[43] See Beyer, Gaspar, Gerberding, and Issing (2009), and the papers quoted therein, e.g. Baltensperger (1999), Issing (2005), Neumann (1997) and Neumann (1999).

[44] [Here put reference to Lindsey, Orphanides, and Rasche (2005)]

rowed reserves at initial interest rates →

4. need for adjustment in borrowed reserves →

5. change in interest rates →

6. countervailing force to drive nominal incomes/inflation back to target.

In the larger, and more important, sense, the policy worked perfectly as planned. Interest rates were allowed to shoot up,[45] despite the resulting recession, and inflation did fall back sharply. Both Volcker and Reagan take credit for allowing this to work through, in spite of the skepticism initially expressed in several quarters,[46] and of the heavy recession that followed.

[**Figure 3.2**]

But some of the technical relationships in the above causal sequence did not work exactly as expected, and there were some additional external shocks, notably in the form of the imposition, by President Carter, of direct credit controls in March 1980, and their removal in the subsequent July. In particular, the short-term relationship between nominal incomes, interest rates and money (velocity and demand for money functions), became most unsettled. Moreover, expectations of future inflation, as evidenced by long term interest rates, were slow to subside.[47] The result was a hugely bumpy and disturbed ride in interest rates, monetary growth and output.

Quite a long time prior to this episode (Axilrod, 2009, pp 50-51), the Fed had moved the reserves requirements onto a two-week lagged basis, for the convenience of member banks of the Federal Reserve System. But this meant that the adjustment mechanism, at least initially, had to go through interest rates rather than *via* direct shifts in monetary and credit aggregates (as the monetarists would have wished through the monetary base multiplier). There was much debate to account for the volatility in these variables,[48] and no firm conclusion was reached, then or since.

[45] The discretionary limits to interest rate volatility that were in place were hardly ever exercised, (Sternlight and Axilrod, 1982).

[46] In an editorial published eight days after the launch of the Volcker disinflation, the *New York Times* thus commented: 'Mr. Volcker is a gambler. He is betting high, with a poor hand. The entire nation needs to hope thathe beats the odds'.(As quoted in Morris (2009)). [Also put the quotation from the Council of Economic Advisors' macroeconomic projections, as discussed by Mankiw ('Not even the Reagan administration believed in the Volcker disinflation').]

[47] See Kozicki and Tinsley (2005) and Goodfriend and King (2005).

[48] Goodhart (1989): 'Monetarists ascribed both failings to a lack of zeal in the Fed, and to the modifications from full mbc outlined above, and advocated such measures as a shift to current [reserve] accounting, (adopted in 1984), and closure of, or greater penalties from using, the discount window, and/or a shift from using non-borrowed-reserves to a total reserves or monetary base operating target, viz Poole (1982), Friedman (1982, 1984a, b), Mascaro and Meltzer (1983), McCallum (1985), Rasche (1985), Brunner and Meltzer (1983), Rasche and Meltzer (1982). The Fed often advanced particular conjunctural explanations for each short-term surge, or fall, in M1 (see the studies by Wenninger and associates from 1981 onwards, e.g. Radecki and Wenninger, 1985), and Bryant (1982) provided econometric evidence to support the claim that little, or no, improvement in monetary control could have been obtained by changing the operational basis, e.g. to a total reserves target, see Lindsey et al. (1984), and Tinsley, et al. (1982). Others regarded such fluctuations as the inevitable result of trying (too hard) to impose short term control on a monetary system wherein

By the autumn of 1982, however, inflation had fallen sharply, whereas not only was the U.S. just recovering from a recession, but this had spilt out world-wide, especially to primary producing countries, who suffered a combination of sharp reductions in commodity prices and demand, just when interest rates rocketed upwards. The second most severe financial crisis of our period erupted in August 1982, when Mexico, Argentina and Brazil all threatened to default on their massive borrowings from banks in developed countries, especially from city-center banks in the U.S.,[49] on which more later.

It was time to return to a steadier, less erratic policy regime. This was done by changing from a non-borrowed reserve target to a borrowed reserve target. This sounds, superficially, like a minor technical detail (and such may have been part of the intention), but it was, in practice, as different as chalk and cheese. The banks' demand for borrowed reserves depended primarily on interest rate differentials; hence a target for borrowed reserves is implicitly equivalent to setting a target for the Fed Funds rate. In contrast, the non-borrowed reserve target had forced interest rates to adjust to equilibrate the gap between the reserves required by actual monetary growth relative to those made available by Fed operations. Interest rates and monetary growth therefore then stabilised, the standard deviation of Fed Funds rate, 10 year Treasury bonds and M1 growth were as follows:

[Table 3.3]

3.1.2 The United Kingdom

A somewhat similar sequence occurred in the U.K. (Goodhart, 1989), *mutatis mutandis*, though it was the politicians—Thatcher, Keith Joseph, Howe and Lawson[50]—who drove the new policies forward, rather than a quite reluctant bank of England, and more of the cutting edge of disinflation came *via* the exchange rate (also influenced by the arrival of North Sea Oil) rather than by interest rates. In the U.K. as in the U.S., the monetary aggregates were affected by (the removal of a version of) direct credit controls (the Corset was abolished in June 1980), and the monetary target (£M3, as set out in the Medium Term Financial Strategy) misbehaved itself comprehensively. In the U.K. as in the U.S., monetarist economists called for the adoption of monetary base control, but the bank of England and the banks were opposed and fought off that proposal. Nevertheless the overall thrust of policy—including a contractionary Budget in March 1981—which brought forth the famous letter of denunciation signed by 364 economists in *The Times* of March 31st, 1981, whose arguments still remain a battleground,[51] remained determinedly deflationary.

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there were lengthy lags in the adjustment of the demand of both deposits and advances to interest rates (instrument instability), (e.g. White, 1976; Radecki, 1982; Cosimano and Jansen, 1987, but see Lane, 1984 and McCallum, 1985 for an attempted rebuttal).'

[49] And Continental Illinois had run into difficulties in July.

[50] [Put references]

[51] [Put references to Congdon and Nickell]

As inflation fell in the U.K., as intended, the severity of monetary policy lessened. But the inability to predict velocity, at least for £M3, and the collapse of the associated demand for money function, led to the adoption of two additional monetary targets, M1 and PSL2, a wider liquidity variable. Given three targets, there was more likelihood that one would be hit. This left more room for policy discretion and weakened the strength of commitment to monetary targets.

With the U.S., the U.K. and Germany all embarked on disinflationary policies, using some version of monetary targetry, in the years 1979-82 the rest of the world tended to follow suit, though often *via* pegging to one of these policy leaders, rather than by domestic monetary targetry. Thus in France Delors persuaded Mitterrand in 1983 to tie the French franc to the DM, in the 'Franc Fort' policy. The ERM, established in 1979, hardened, and the Bundesbank became the 'bank that Ruled Europe'.[52]

3.1.3 Australia

Outside Europe, in Australia, after several years of volatile and fast monetary growth (M3 growth peaked in the year to December 1975 at 22%), the monetary authorities began to target M3 growth in March 1976 by announcing the 'expectation' that seasonally adjusted annual M3 growth in the six month to June 1976 would be within the range of 11-13%. Then, in subsequent government budgets each August, M3 growth for the following twelve months was projected.

After successfully reducing the growth and volatility of the money supply, and inflation, in the first two years of the targeting regime, M3 growth accelerated as a result of:

1. difficulties in controlling bank lending. In particular, overdraft lending was prevalent in Australia. This meant that even if the banks adhered to the central bank's limits on annual increases in overdraft limits, individuals could increase their usage of existing limits. This could lead to uncontrollable swings in M3.

2. A marked improvement in the balance of payments.

Inflation picked up significantly in the early 1980s as a result of the rise in international oil prices and a rapid increase in domestic labour costs. This required an exceptionally large tightening of monetary policy, just at a time of worldwide recession. Real short term interest rates rose to unprecedented heights. M3 growth however did not respond by falling as sharply as had been hoped, given the scale of the monetary tightening and the severity of the recession (the worst seen since the 1930s). Confidence in the ability to target monetary variables fell off considerably.

The flaws of the system became apparent. It became widely accepted that the regulatory regime in place[53]

[52] See Marsh (1992) and Gros and Thygesen (1992).

[53] See Argy (1990).

> 'had hindered the development of the banking system, but had not really been effective in rationing finance provided to the private sector.'

A more relaxed approach gradually ensued. While the M3 projection remained, direct controls on bank lending were removed, and from 1983, the currency was allowed to float freely, as speculative capital inflows had proven very difficult to contain. banking deregulation was swift, culminating in the participation of foreign banks within the domestic banking system from 1985. Competition and innovation in banking led to the rapid growth of M3 as banks gained market share from non-bank financial intermediaries, causing M3 growth to be persistently and significantly above projected levels. As a result, the relationship between the growth in nominal money aggregates and GDP growth and inflation broke down. In the year to June 1985, for example, M3 growth was 17.5%, (versus a projected range of 8-10%.) while inflation was falling.

3.1.4 Canada

In Canada, money supply targeting began with the announcement in late 1975 of a target band for M1 growth of between 10 and 15% in 1976, with the explicit aim of containing money supply growth in the medium term in order to bring down inflation. The Canadian approach is best described as 'gradualist'—the M1 band was broad and set at a high, achievable level at first, and was brought down slowly, mostly in a series of one percentage point steps. This strategy was designed to accommodate growth in real output, whilst applying moderate downward pressure on inflation. M1—the narrowest measure of money in the Canadian economy—was chosen, due to its historical responsiveness to short term interest rates.

By international standards, the Canadians were the most successful at achieving their targets for money supply growth. Nevertheless, the policy was abandoned in 1981 for two reasons. First, innovation in the banking sector—primarily the introduction of chequable savings accounts which paid daily interest—led to a large flight out of M1 in 1981. Inflation, however, was high.

> 'Taking M1 at face value would have meant an easing of policy at a time when inflation was high. On this occasion, the extent of the adjustment required could not be estimated with confidence, and the bank of Canada abandoned monetary targeting.'[54]

Secondly, M1 was too narrow a measure to target. Research at the central bank showed that M1 had a very high interest elasticity of demand, meaning that only small changes in interest rates were required to keep M1 within its target band. This in turn meant that monetary policy had little impact on real output or prices, and failed to act as a nominal anchor (Thiessen, 2001).

[54] See Argy (1990).

Canadian policy therefore moved in a discretionary direction—movements in monetary aggregates were monitored, but were considered too unreliable to target. As Govenor Bouey proclaimed, 'we didn't abandon the monetary targets, they abandoned us.'[55] Alternatives were attempted, including a brief period during which nominal income was used to guide policy, but it was found to be too difficult to predict accurately, and too difficult to communicate to the public.

3.1.5 Japan

The bank of Japan (henceforth, BoJ) announced the introduction of a 'money supply policy' in July 1975, following the lead of the U.S. and European central banks. From July 1978, the BoJ began to publicly announce quantitative 'forecasts' at the beginning of every quarter for the annual growth of M2 (money in circulation plus demand and time deposits with the commercial banks; from 1979: M2 plus certificates of deposit - M2+CDs). 'Forecasts' were chosen in place of targets. M2+CDs deemed to be the most important monetary indicator because of its leading qualities over income and expenditure. Conversely, while M1 has a closer statistical relationship with income and expenditure, it did not lead the latter in Japan.

The move to the 'money supply policy' was motivated by Japan's experience in the early 1970s of high and volatile inflation and money supply growth, and the recession. In the initial years, the 'money supply policy' brought about an improvement in all these indicators: money supply growth fell from 15-25% per year to a much narrower band of 7-12% for the entire period 1978-89. In addition, the average growth rate of real GNP was around 5% per year for most of this period (except for during the worldwide recession in 1981-83). Inflation moderated from a peak of a little over 20% in 1973 to around 2% in 1986.

However, mismanagement of monetary policy in the second half of the decade, as is described later, is often cited as the cause of the asset price bubble of the late 1980s and subsequent 'lost decade' of the 1990s.

3.1.6 Conclusions

This episode, 1979-82, in most countries came to be known amongst central bankers under the general title of 'Practical Monetarism'. It had the following common characteristics:

a) a belief in the medium and longer term reliability of the relationship between monetary growth and nominal incomes/inflation;

b) a belief that velocity (demand for money) functions were sufficiently predictable/stable to act as 'intermediate targets';

c) a belief that interest rate elasticities were such as to allow appropriate adjustments in both expenditure functions and monetary aggregates;

[55] House of Commons Standing Committee on Finance, Trade and Economic Affairs, Minutes of Proceedings and Evidence, No. 134, 28 March 1983, p. 12.

d) a deep hostility to monetary base control methods.

Characteristics (a) and (d) remain; (c) was just about good enough; but (b) collapsed.

So, what next?

3.2 An external peg?

As the above record indicates, a remarkable common feature over the years 1979-82 was the collapse of the (supposed) prior stability of velocity, and of demand for money functions, in a range of countries, especially those with an 'Anglo-Saxon' background, e.g. Australia, Canada, the U.K., and the U.S.. Why did this occur? One argument was that the prior econometric relationships had been misspecified; that the in-sample fits could not be expected to hold as well out of sample; but that further, improved econometric methods might restore the (previously expected) predictability of the relationships.[56] Another argument (the Lucas critique; Goodhart's Law) was that the very act of transforming a monetary aggregate into an 'intermediate' target was likely to change behaviour, including the authorities' own behaviour, and thereby alter prior 'structural' relationships. One aspect of this latter was that nominal (and real) interest rates became both much higher and much more volatile than in the past. Moreover, the nature of the monetary regime, and its probable success, became much more uncertain. Against this background of highly volatile interest rates and of enhanced uncertainty, banks innovated to protect their market position, for example by offering interest rates on demand deposits, and bank customers similarly adjusted their own behaviour to react to the new conditions.

Whatever explanation might be preferred, such instability presaged the demise of monetary targetry, with the partial exception of Germany, where monetary targetry had been least compromised by such instability.[57] So the German Bundesbank carried on with its policies of combining monetary targetry with anti-inflationary zeal, the latter in a proto-type Taylor rule fashion. German monetary policy in these years is described in Beyer *et al.* (2009), and the literature therein reported.

But, if monetary targetry had been found wanting, what else could be tried? In the other main central country (besides Germany), the U.S., there was no clear, strategic thinking on the subject. Instead there was a, somewhat disguised, retreat, under cover of the change to a borrowed reserve target, back from monetary targetry to the same process as had been applied prior to 1979, of relating interest rate decisions directly to deviations of output from its estimated equilibrium, and of inflation from some, undisclosed, desired level or range (Thornton, 2005). But following the Great Inflation of the 1970s, the coefficients on inflation in such a proto-type Taylor rule were supposed to be somewhat higher (above unity), and somewhat lower on output

[56] (Hendry and xxx, 19xx)

[57] Some [references to be found] attributed this to the early liberalisation of the German financial system, so that there was less incentive for innovation there in these years.

deviations, than prior to 1979. There was a painfully slow and hesitant traverse from the shift to a borrowed reserve target to a realisation that the FOMC was, indeed, actually setting an official short term interest rate, the Fed Funds rate, and from that point to becoming transparent about that by giving a public announcement (not until 1994) of that target value. In the first few years after 1982 this lack of clarity reflected some confusion in the FOMC about what they were actually doing, and thereafter could, perhaps, be excused in part by the fact that monetary policy measures were relatively successful, in keeping inflation under control, in responding to the October 19th New York Stock Exchange crash in 1987, and in mitigating the 1988-90 boom and 1991-92 recession.

The other, medium and smaller-sized (developed) countries did, however, have an alternative strategy to hand. This was to peg their currencies to that of one or other of the comparatively more successful central countries, Germany or the U.S.. Even if the monetary regimes in these countries were less than fully explicit, they had been relatively successful in practice in restraining inflation and stabilising output. Smaller countries, with less confidence in their own capacities to manage macro-economic monetary policies, could tag on to the better policies of their stronger neighbour.

So, over the period 1985-89, this was what was done in many countries. On the continent of Europe, after an initial 'turbulent period', 1979-83, in which there were many rate adjustments,[58] the exchange rate mechanism of the European Monetary System (henceforth, ERM and EMS, respectively) entered a 'calmer' period, 1983-1992, in which countries made maintenance of their ERM peg to the DM the centrepiece of their own monetary policy.[59] The Bundesbank became 'The bank that Rules Europe' (Marsh (1992)). The Bundesbank set its interest rate, as described above, according to its assessment of the best interests of Germany, and the other countries in the ERM tagged along.[60] Initially these other countries comprised Benelux, Denmark, France, Italy and Ireland, but Spain joined in 1989, the United Kingdom in 1990, and Portugal in 1992 (Greece joined much later, in 1998).[61]

Outside Europe, the tendency was also to pay more attention to relative exchange rates, especially to the bilateral rate *vis-à-vis* the U.S. dollar, but without going so far as to peg formally against the U.S. dollar. Thus in Canada, the central bank was largely impotent for much of the latter part of the 1980s: the bank lacked credibility and a clearly articulated strategy. Because of weak investor confidence in the Canadian economy and its economic management, the bank found itself moving interest rates in response to U.S. rate decisions in order to 'defend the Canadian dollar'—a policy that produced exaggerated swings in Canadian interest rates which weakened the domestic economy and fuelled this feedback loop.[62] Inflation expectations were

[58] See Gros and Thygesen (1992, Chapter 3).

[59] See Giavazzi and Giovannini (1989).

[60] As did Austria; but its political position, *vis-à-vis* Russia and East Europe, constrained it from being a member of EMU.

[61] See the 1998 *Convergence Report* of the European Monetary Institute, and Bernholz (1999).

[62] 'A sudden increase in U.S. interest rates, for example, would put sharp downward pressure on

also poorly anchored during this period, weakening the potency of monetary policy.

Meanwhile in Australia, the M3 target range was replaced in early 1985 by a far more discretionary regime. Rather than having a specific target, the central bank announced, in May 1985, a 'checklist' of economic variables that it would monitor, including monetary aggregates, inflation, the external account, the exchange rate *vis-à-vis* a basket of currencies, asset prices, and growth prospects, in order to make policy decisions.

This approach also had its problems. In particular, policy in the second half of the 1980s was criticised for lacking a clear conceptual framework and for allowing too much scope for central bank discretion. Monetary policy lacked a nominal anchor, and became difficult to communicate effectively to the public: 'It failed to distinguish between the instrument of monetary policy, intermediate targets and ultimate targets.' (Macfarlane, 1998). Nevertheless, inflation in Australia fell, and a period of relative stability presided for much of the second half of the decade.

3.2.1 Other countries

Japan Japan is, perhaps, particularly difficult to categorize in this respect. On the one hand, Japan is a large economy which might be expected to set its monetary policy, like the U.S. and Germany, almost entirely in response to domestic considerations. On the other hand its bilateral exchange rate with the U.S. was of key importance, both for political and economic reasons. The degree to which the monetary authorities in Japan responded to domestic or external stimuli varied depending on the political conjuncture.

A strong appreciation of the Yen caused a domestic recession in 1985 (the *endaka* recession). In response, the bank of Japan lowered interest rates by 250 basis points between January 1986 and February 1987 and then held them at 2.5% from February 1987 to May 1989. Despite a strong pick up in economic activity from 1987 onwards, and the strong growth of M2+CDs (the annual rate of growth picked up from 8% in the first quarter of 1987 to 13% in April 1990), the bank of Japan did not tighten monetary policy. Why? There are several possible reasons for that.

a) International policy coordination The bank of Japan was compelled to keep interest rates low due to imbalances in the global economy. A series of G-5 and G-7 meetings in the mid-1980s, beginning with the Plaza Agreement in September 1985, required the bank of Japan to pursue expansionary monetary policy to stimulate domestic demand in order to reduce its current account surplus and to help America reduce its current account deficit. Of the five reductions in the official discount rate,

the Canadian dollar, causing import prices to rise and raising concerns about the future course of inflation. Because inflation expectations were not firmly anchored, prices in other areas of the economy would also come under upward pressure, setting off a potential inflationary spiral. Investors, worried about the future value of their money, would start to demand much higher rates of interest. The end result was higher interest rates, a weaker dollar, and much stronger inflation expectations than the domestic economic conditions alone would warrant.' (Thiessen, 2001).

only the first was implemented independently by the bank of Japan. In the subsequent four 50-basis point cuts, the bank of Japan lowered rates in coordination with other central banks.

b) *The prevention of yen appreciation* Japan's position in the global financial system, particularly in its role as a creditor nation, had increased in importance over the 1980s. The Louvre Accord in 1987, of which Japan was a signatory, required countries to 'cooperate closely to foster stability of exchange rates around current levels.' Interest rates were therefore held low in order to prevent the appreciation of the Yen which would have destabilised the world economy and damaged the domestic recovery, given the significance of exports in the Japanese economy. While formally price stability remained the explicit aim of the bank, its independence was clearly compromised when government pressure reached 'a point where preventing the yen's appreciation became a national policy.' (Okina *et al.*, 2001). Monetary policy failed because it was used in an attempt to achieve multiple goals (exchange rate stability; price stability) with one instrument (interest rates).

c) *The breakdown of the link between money supply growth and inflation* Despite the strong pick up in money supply growth between 1987 and 1990, annual domestic wholesale price index (WPI) inflation never exceeded 2%. But, crucially, the WPI did not account for the rapid increases in asset prices, particularly equity and land prices, seen during the second half of the decade. Indeed, the rapid expansion of credit in the late 1980s fuelled a self-perpetuating bubble (credit was secured against assets; increases in asset prices allowed companies and citizens to borrow more; agents borrowed to invest in assets; etc.) The BoJ failed to check this bubble, given the weakness of inflation for normal goods. Okina *et al.* (2001) best summarise the mood:

> '[...] at the time, the rise in asset prices was mainly discussed from the viewpoint of equality of income and asset distribution, and was not seen as inducing large fluctuations in the economy from a medium- to long-term viewpoint. Accordingly, the large increase in money supply was not taken seriously [...]'[63]

d) *The weakness of the transmission mechanism* Similar to other countries, the 1980s saw widespread financial deregulation in Japan. A by-product of this was the disintermediation of the Japanese banking sector. Large firms increasingly used the capital markets for their funding requirements. Private and institutional investors took advantage of superior interest rates on offer in the capital markets by moving funds from banks into newly authorised products. These were open to institutional as well as private investors. The upshot of these structural changes was that the effectiveness of monetary policy to affect the growth of lending and money in the economy by influencing interbank interest rates through market intervention weakened considerably.

[63] See Okina *et al.* (2001, p. 42).

The BoJ was therefore slow to move interest rates. Had the BoJ acted earlier, then, according to calculations in Bernanke and Gertler (1999), the emergence of the bubble could have been prevented if interest rates had been raised from around 4% to 8% in 1988.

But the BoJ was not entirely to blame for the bubble. The government programme of financial deregulation fuelled the expansion of credit, a large inflow of foreign capital, and investment in assets. From 1975, foreign currency holdings of up to ¥3m were permitted; from 1980, this ceiling was entirely removed. Borrowing by Japanese residents in foreign-denominated currencies was subsequently liberalised. The holding of foreign securities by Japanese residents, and domestic securities by non-residents, was also completely liberalised in 19[**??**].

The most important reforms however were those that enabled the disintermediation of banks (mentioned above) and the intensification of competition in the financial services sector as a result of the deregulation of interest rates in 1985. The latter took away economic rents from banks. In order to try and recapture former levels of profitability, bank lending practices became increasingly aggressive. Loans to small businesses backed by property and property-related loans ballooned, fuelling an unsustainable boom in asset prices. Most economists seem to have concluded that monetary policy was accommodative, but it was not the root cause of the economic crisis.

During the period 1979-90 exchange rate relationships between the big three countries remained volatile. As noted earlier, the U.S. dollar was exceptionally depressed at the start of this period, in 1979. Thereafter the new monetary regime, established by Volcker, led to sharp increases in U.S. real interest rates, and to a strong recovery in the dollar exchange rate over the years 1979-83. This then overshot between 1983 and 1985, for reasons that are still difficult to understand, with an excessive dollar appreciation. Although there was much talk about the putative role of international monetary cooperation, notably at the Plaza and Louvre summits, most of the subsequent reversal in the $/DM and $/Yen rates probably just represented a normal market readjustment, which in turn may have slightly overshot by 1987.[64] Despite the weakening of the dollar exchange rate, the U.S. trade balance continued to deteriorate. This led the U.S. government to put pressure on Germany and Japan to reflate their domestic economies through fiscal measures, which would also lead them to keep interest rates higher than otherwise, and hence preserve U.S. competitiveness. Disputes about how to resolve current account imbalances were, it has been suggested,[65] partly responsible for the Stock Market crash in October 1987.

[**Table 3.4**]

The ERM The ERM was also subject to a number of inherent strains. A fixed exchange rate system is always at risk from an asymmetric shock affecting some but

[64] See Volcker and Gyohten (1992, chapters 8 and 9).

[65] [Put references here]

not all of its members, especially when it impinges mostly on the centre country. Such a shock occurred with the German reunification in 1989/90. The economic transition was badly handled, and resulted in a massive fiscal deficit (transfer payments to the East), a construction boom in the East, and incipient inflation. The Bundesbank reacted aggressively by sharply raising interest rates, just when several other members of the ERM were beginning to move into recession in 1991/92.

The other main weakness of a pegged, but adjustable, exchange rate was that it allowed for, even encouraged, speculation. It was usually obvious, if there was to be a realignment, which countries would be candidates for devaluation or revaluation. So the candidates for possible devaluation would have to raise interest rates well above those in countries likely to revalue; and if they were forced into devaluation their interest rates would then be pushed back down, despite the inflationary impulse from the devaluation itself. So, in such a pegged, but adjustable, exchange rate system, real interest rates could become both volatile and inappropriately reinforcing the economic cycle. It was for such reasons that Alan Walters famously described the ERM as 'half-baked'.[66] Conditions in 1991/92, when Germany was holding nominal, and real, interest rates up, while several peripheral countries were facing recessions, e.g. in Finland, Italy and the U.K., but had to raise interest rates to fight off speculative concerns about devaluation, were an example of the most severe tribulations of such a system.

[Figure 3.5]

There was more stomach to accept such pain, if ERM/EMS was perceived as part of a larger (political) process towards eventual monetary and economic union. But in the U.K., where entry into the ERM had been perceived by the Conservative government as an economic stratagem without longer-run political implications (a position whose logical foundations were queried by the Tory euro-sceptics), it was more difficult to bite the bullet. Meanwhile Italy was widely perceived as a country with little macro-economic discipline and a consequential greater need for occasional devaluations to restore competitiveness.

All this blew up in September 1992 when Italy and the U.K. were forced out of the ERM, and Spain devalued. But the crisis of the ERM did not stop there, but rolled on further, forcing further devaluations in Spain and Portugal (five realignments in eight months), a float by Sweden after a titanic struggle (in which the Riksbank at one stage had overnight interest rates at over 1000%!), and several major speculative attacks on the French Franc (Marsh (2009)). The crisis terminated (end July 1993) with an agreement to widen the bands of the ERM by so much, to 15%, that the ERM effectively had been replaced, *pro tempore*, by a free float.

This set-back did not deter those enthusiastic for greater long-term economic and monetary union. It simply under-scored the point that a period of maintaining pegged, but adjustable, exchange rates in a narrow band is neither a necessary, nor even perhaps a desirable, precondition for entry into a monetary union. But it did

[66] [Put reference here]

mean that, absent such a desire to move into a permanent monetary union in due course, a policy of pegging exchange rates to a neighbouring country while still purporting to maintain monetary sovereignty, and the ability to adjust exchange rates, was shown to be fragile.

So for most countries, outside the U.S. and Germany, a second monetary strategy (regime), of exchange rate targeting had been adopted, and also found wanting, just as monetary targetry had also failed previously.

What next?

3.3 Inflation targets

What came next was inflation targeting. This was initially adopted in New Zealand in 1988/89 not so much as an alternative target to exchange rate pegs, but rather as one aspect of a wider ranging reform of the governance of public sector corporations there (Singleton, *et al.*, 2005 and 2006). The previous (National) government, led and dominated by Sir Robert Muldoon, had intervened and meddled in, and sought to micro manage, all aspects of the New Zealand economy, especially the public sector corporations, including the Reserve bank of New Zealand (henceforth, RBNZ).

Muldoon acted as his own Minister of Finance:[67]

> 'He implemented a system of widespread interest controls, coupled with a wage-price freeze and reverted to a fixed exchange rate. The bank advised against adoption of these policies, favouring a shift to less interventionist policies with greater reliance on interest rate flexibility, but was overruled by the Minister.'

Another interesting feature of the NZ scene was the economic role reversal of the two main parties, with the (supposedly right wing) National party having adopted interventionist, statist, direct controls. So, in opposition, the (supposedly left wing) Labour party espoused more liberal, market-friendly policies. When they came back to power, in 1984, the Prime Minister, David Lange, and, even more so, his Minister of Finance, Roger Douglas, determined not only to dismantle the existing system of direct controls, but to try to construct a new structural system which would prevent the readoption of such direct controls in the future.

As noted in Singleton *et al.* (2006, pp. 11-12),

> 'Officials were working [in 1983] on desired monetary control mechanisms to respond to these issues. The election [in 1984] took the field of endeavour further, however. The new Minister of Finance, Roger Douglas, verbally communicated to officials that he wished to 'Muldoon-proof' future monetary policy, meaning that he wished to implement a new institutional structure for

[67] See Singleton *et al.* (2005, p. 5).

monetary policy that would prevent mis-use of the monetary printing presses. Later, in the 1988 Budget, he explained this objective as 'to make certain that no future politician can interfere with the bank's primary objective of ensuring price stability, or manipulate its operations for their own purposes, without facing the full force of public scrutiny [...]. While there appears to be no formal documentation of the Minister's initial request to work on this topic, the request to 'Muldoon-proof' monetary policy is well-entrenched in the institutional memory of the bank and the wider policy community. That the request did originate from the Minister is clear from a July 1986 memorandum from the Governor to the Minister stating 'You have expressed an interest in changing the legal/constitutional position of the Reserve bank so as to increase the bank's autonomy, in order to enhance its ability to promote stable and consistent policies for New Zealand in those areas for which the bank has particular responsibility."

There was, however, a problem. As Singleton *et al.* (2006, forthcoming **[???]**, pp. 12-14), reported:

> 'At the same time as bank officials were working on new monetary policy regimes, Treasury officials were working on a wide range of public sector reform policies, both for core government departments and for other state entities. A key aspect of these reforms were policies to be applied to State Owned Enterprises (SOEs). Treasury and the State Services Commission (SSC) considered it important that the bank comply with the rest of the state sector in adhering to the new public sector management ethos, preferably along the newly established SOE model.
>
> Through the period of financial deregulation in 1984 and early 1985, Reserve bank officials concentrated primarily on monetary policy issues rather than on contemplation of new institutional structures along the SOE model. However once the main deregulation policies had been implemented, internal attention shifted towards these broader institutional matters [...].
>
> One key aspect of the framework, which would foreshadow a long debate between the bank and Treasury, was its consideration that it was desirable to attack problems of monopoly power and to treat SOEs as far as possible the same as comparable private sector firms. The SOE framework would do this by removing any legislative or regulatory barriers to entry to a market, so that the enterprise faced competition or the threat of competition.'

The problem was that central banks had developed into monopoly providers of base money. An explanation of why this had happened is given in Laidler (2003/2004, pp 45/6); also see Goodhart (1988) and Congdon, (1996 and ?). It was, therefore, difficult to fit the RBNZ into this latter competitive framework. In this context, Roderick Deane, the Deputy Governor, asked Peter Ledingham to write a survey

(think-piece) on its institutional structure in the light of the 1985 Treasury note. He came up with,

> 'three options for monetary policy - (*i*) free banking (i.e. no monetary policy); (*ii*) some Government-imposed stable standard of value (i.e. exchange rate or price level or inflation targeting); and (*iii*) some Government-imposed targets aimed at all the objectives of economic policy - he concluded that only the second made sense. The first was impractical, and the third could lead to different agencies pursuing objectives with different weights. Further, while acknowledging that there may be a short term trade-off between inflation and other objectives, Ledingham concluded that there was little or no long-term trade-off. Thus, for stability, monetary policy should be assigned to the inflation objective. He added: "Moreover, proper accountability for the conduct of policy requires a fairly strict assignment of instruments to objectives".'[68]

It was thus Ledingham who gains the credit for insisting that the RBNZ should have a single target for price stability,[69] but the question of how that should be made operational was left for discussion; and the need to specify an agreed, quantitative target, which should be wholly, or partly, decided by government, came out of the wider SOE framework.[70]

A key feature of inflation targetry is that the government sets the target for inflation, which the central bank is then asked to achieve by varying its main instrument,

[68] See Singleton *et al.*, *ibid.*, p. 17.

[69] Though Grimes (1987) supported this in an internal paper, stressing the time inconsistency analysis.

[70] At this point (in November 1986) a major spanner got thrown into the works. An economist at Treasury, Paul Atkinson, came up with an entirely different blue-print, 'Monetary Reform: An SOE Framework for the Reserve Bank', the merits of which he managed to persuade his Treasury colleagues. This combined constraining the Bank's ability to expand the note issue at the same time as encouraging it in other respects to act as a competitive commercial bank, which could be allowed to become bankrupt in the normal way, (if so, the Minister would take over). Most other functions of a Central Bank, including foreign exchange management, debt management, research and forecasting, and supervision – if the latter was to be retained at all – were to be undertaken in a separate Services Division, directly funded by government, in practice a government department.

This was a remarkable throw-back to the Ricardian (Monetarist) ideas of the Currency School of the 19th century. Indeed, "The Treasury proposal envisaged the Bank being set up in 3 departments: an Issue Department, a Banking Department, and a Services Department"; this was almost a carbon copy of the 1844 Bank of England Act. As may be imagined, "Internal Reserve Bank reaction to the Treasury document was negative" (Singleton et al, 2006, p. 30). This "led to an intense period of debate about the finer points of the autonomy proposals", (ibid, p. 30).

One of the main issues in the Bank/Treasury dispute was whether the single objective, or target, should relate to measurable, intermediate 'outputs', such as the note issue or the monetary base, or to 'outcomes' such as the inflation rate. It was, on this front, fortunate for the RBNZ position that, formerly apparently stable, established relationships between monetary variables and nominal incomes had collapsed so patently in both the USA and UK in previous years. Hence the Bank could claim support for its position from (moderate) monetarists (like Laidler) as well as more eclectic economists.

the official short-term interest rate. Using the terminology of StanleyFischer (1994), the central bank has operational independence, but not goal independence, thereby combining democratic legitimacy with operational autonomy.

But whereas governments may secretly want expansionary, and more inflationary policies at times of difficulty, and before elections (time inconsistency) they are almost bound, for a variety of reasons, especially in view of the effect on expectations, to assert in public a conservative, low, target for inflation. Thus having a published target for inflation virtually locks the government into supporting the central bank in its quest for price stability.

This was perceived by John Crow, the Governor of the bank of Canada, who campaigned for the adoption of a similar IT policy (Crow, 2002) in Canada. This was granted in 1991, by the [Conservative] Government there. Crow then applied restrictive policies, to achieve the target, which became a hot campaign issue in the election there of (When?). Although, following their sweeping victory, the new Liberal government engineered Crow's departure, they re-affirmed the IT policy structure. Indeed, there are virtually no cases, as yet, of a country once having adopted IT subsequently replacing it by a completely different regime, though there have been changes in the parameters used, e.g. choice of inflation index, width of bands, etc.

When the U.K. was forced out of the ERM on September 16, 1992, the Conservative Government 'lost not only credibility, but also a policy' (Lamont (1999), p. 274.). Lamont went on to note (*ibid.*, pp 274/275) that

> 'The urgent task was immediately to begin the construction of a new policy. I wanted to show the aims of Government policy remained the same although we needed different means for achieving them. The object of policy had always been low inflation and recovery [...].
>
> Many people at that time, not just in the Treasury, thought that there was a great risk that inflation would rise again through the sudden depreciation of sterling [...].
>
> The great danger I foresaw was that outside the ERM, particularly as we were a Government under pressure, decision-making would now be seen as entirely political. One solution would have been to make the bank of England independent, but I knew the PM would not go that far. The steps I was proposing would ultimately lead to independence for the bank of England.
>
> Thus began a rapid search for a new policy. It had to be done quickly, because politics demanded that, but it also required care. The reconstruction of policy was done step by step.'

The Prime Minister, John Major, agreed. He wrote, (*op. cit.*, p. 667):

> 'After Black Wednesday we could not return to the pre-ERM strategy of monetary targets and 'taking account' of the exchange rate; it was vital to develop a new strategy. I had a meeting with Sarah Hogg, Norman Lamont

> and Terry Burns from the Treasury on 22 September at which we discussed the options. Our objective was a low-inflation economy. Norman developed the theme in meetings at the Treasury, while Sarah fed in more ideas from Number 10 and liaised closely with Terry Burns and Treasury officials. Eddie George, the Governor of the bank of England, which would have a more public role, was closely involved throughout. We agreed to set a target for the rate of inflation.'

The arguments, and background papers, presented at such meetings have not yet been made available to the public, so we do not know which protagonists and arguments won the day. Moreover, once the decision had been taken, the politicians took personal responsibility for the new development in policy, as is indeed their constitutional duty, rather than emphasising the provenance and prior application of the idea elsewhere.

By that date, however, the idea of setting an inflation target as the anchor for monetary policy had begun to catch on. The New Zealand example had begun to be noted, for example by Peter Norman in his Economics Notebook article of 6 November, 1989, on "New Zealand sets an example", Financial Times, p. 21. The experience, so far, in New Zealand had been good, and inflation targetry had a number of clear advantages, especially in comparison with the previous attempt at monetary targeting. The latter was perceived as having failed; whereas inflation targeting was novel, and so far appeared to have been reasonably successful. Monetary targets could be, and were (McCallum 2001, Laidler 2003), described as being the same as inflation targets, but with the (considerable) additional advantage of getting rid of the noise from residual variations in demand-for-money (velocity) functions. Monetary targets related to statistical abstracts about which the public cared little, and understood less, whereas inflation was not only easily understandable, but also a subject of direct and immediate public concern.

Nevertheless initially Lamont coupled a direct inflation target with some companion monetary targets, but these latter soon became ignored and were abandoned. More important, there were political objections at that time in the U.K. to giving the bank of England full operational independence, though they were given a more public (and more independent) role, bit by bit (Goodhart, 2009), until the bank was given such independence in one of the first acts of the new incoming Labour government, announced May 1997 (bank of England Act 1998?).

Thereafter, during the course of the 1990s, this new regime became adopted by almost all other countries, except for the U.S. and the remaining set of countries who used a (harder) exchange rate peg, such as a currency board (e.g. Hong Kong, Argentina, Estonia, etc.). As of [June 2009] X countries have formally adopted IT, and none so far have abandoned it.

In an influential, but misinterpreted, earlier paper, Sargent and Wallace (1975) had demonstrated that, should a central bank adopt some fixed level of nominal interest rates, and stick to that, then the price level would become indeterminate, whereas maintaining some growth rate for a monetary aggregate would result in a

determinate inflation rate. This was treated, by academic monetarists, as a main plank in the argument for directly controlling monetary aggregate growth rather than using interest rates as the main operational instrument. The crucial condition for the Sargent-Wallace result to obtain, however, was that the central bank would, arbitrarily, first choose a nominal interest rate, and then stick with that, whatever else was happening in the economy. As Bordo and Schwartz emphasised in their similar Chapter in the *Handbook of Macroeconomics* (1999), there were a succession of monetary regimes, which had an over-riding influence on how, and when, a central bank would react. But as a generality the ethos for a central bank has always been to maintain the internal and external purchasing power of the currency.

So, after the demise of pegged exchange rate regimes (Bretton Woods, 1971, and ERM 1992/93), the focus shifted towards maintaining price stability at home, while allowing floating exchange rates externally. But one aspect of monetary policy upon which virtually all monetary theorists agreed, (except perhaps real business cycle addicts, and they denied the efficacy of monetary policy to affect anything real as a result), was that monetary policy in general, and adjustments to interest rates in particular, acted with a 'long and variable lags'.

So, the main point of concentration of central banks has always been on future forecast inflation rather than current inflation, about which they could do very little, except by massive changes in interest rates leading to wrenching changes in (flex-price) assets, such as exchange rates, equity prices, etc. An excessive focus on current inflation would simply lead to 'instrument instability'. But how does one best forecast future inflation (Refs)? This is generally thought to depend on the present output gap, on inflationary expectations which themselves are a function of current and prior inflation, (and of the central bank's credibility), and in a smaller, open economy on recent changes in the exchange rate.

So in symbols,

$$i_t = b_1 \left(\pi_{t+j|t} - \pi^* \right) \tag{1}$$

where i_t is the nominal interest rate, π_t is inflation, π^* is the target rate of inflation, $t+j$ depends on the lag length of the effect of interest rates on inflation, and $\pi_{t+j|t}$ is the expectation of π_{t+j} based on information at time t.

$$\pi_{t+j|t} = b_2 \left(\pi_t, \pi_{t-z}, ... \right) + b_3 \left(y_t - y^* \right) + b_4 \left(e_t - e_{t-q} \right) \tag{2}$$

where y_t is the level of output, y^* the equilibrium or sustainable rate of output, and $e_t - e_{t-q}$ a measure of the recent change in exchange rates. This, of course, leads on directly to the Taylor reaction function, which for a closed economy is,

$$i_t = a + b_5 \left(\pi_{t+j|t} - \pi^* \right) + b_6 \left(y_t - y^* \right) \tag{3}$$

As long as b_5 and b_6 abide by certain principles, of which the simplest is $b_5 > 1$, (Taylor (1993)), the use of a Taylor reaction function is tantamount to the adoption of an inflation target. Thus the finding that most successful central banks have

behaved in a way that can be empirically described by a Taylor reaction function, satisfying the Taylor principle, is observationally equivalent to stating that most such central banks, including the U.S. Fed, have, implicitly or explicitly, been following an inflation target.

Rather in our view the decision whether to do so, explicitly or implicitly, depends on presentational and constitutional/political considerations. Thus a formal inflation target, set by the elected government, gives more protection to an, ultimately subservient, central bank from political control. On the other hand, a formal inflation target will leave the central bank open to:

i) the, incorrect, attack that it only cares about inflation, (N.B. note that output deviations (gaps) appear in the reaction function and that the authorities can choose how rapidly to aim to revert to target);

ii) attacks whenever inflation moves, significantly, away from target, perhaps under the influence of supply shocks.

As a generality, inflation targets provide a better basis for central bank accountability, but less scope for discretion. In this context Greenspan's preference for not having such an explicit inflation targets is easily understandable. There is, however, the extra complication in the U.S. case that the adoption of an explicit inflation target in the U.S.A would almost certainly require an Act of Congress, e.g. to amend the Humphrey-Hawkins Act of 1978, and any approach to Congress would be fraught with unpredictable danger.

At the time of writing (mid 2009) the regime of Inflation Targeting is subject to more criticism than previously, largely on the grounds that the regime failed to deter the financial crisis of 2007/8 and subsequent recession. This criticism has two main prongs, *first*, that the inflation index was wrongly specified, i.e. that it should have incorporated asset prices;[71] and, *second*, that it unduly constrained central banks from a sufficiently rapid or aggressive reaction to the crisis. We think that the latter criticism is without foundation. We return to this issue in Section [**??**].

3.4 Financial stability

Some patterns of large-scale financial surpluses and deficits are sustainable. During the 19th century, the U.K. and France invested abroad in (then) developing countries for decades, and ran commensurate current account surpluses without any appreciable harm or problems. Some patterns of large current account deficits, and matching surpluses, seem less sustainable; amongst these latter is the pattern of current account surpluses in East Asia (China, Japan, S. Korea, Taiwan) mainly matched by deficits in the U.S.. This appears unsustainable because the Asian countries can hardly want to pile up reserves in low-yielding (safe) reserve assets in Western countries for ever, while so much investment with an expected higher return remains to be done in their own countries. Moreover the counterpart deficits in the U.S. have been matched

[71] [Put references here]

by high consumption and low saving, rather than by investment in tradeable goods, whose exports could eventually pay off the cumulative debt burden.

Be that as it may, any sudden major shift in trade and current account balances is likely to bring with it financing and monetary problems. This was, of course, the case with the oil shock of 1973/74, with a reprise in 1979. This left the oil-producing nations with sudden huge surpluses needing investment, and the oil-importing countries with huge deficits. Most of the oil-producing countries had had prior links with the U.K. or the U.S., (e.g. countries such as Kuwait, the Gulf States, Nigeria, Iraq, Iran, Saudi Arabia and Venezuela), and so tended to recycle their surplus funds there. This made the financing of deficits easy—perhaps too easy—for the U.K. and the U.S..

Besides placing funds in the longer-dated public-sector debt of the major countries in the Western World, the oil producing countries placed their reserve funds in the interest-bearing, and mostly dollar denominated, deposits of the largest Western banks. These banks then lent these funds on to other oil importing countries, often in the guise of large, dollar denominated, syndicated bank loans. This gave considerable further impetus to the growth of the euro-dollar market.[72]

During the 1970s such financial recycling, via the euro-dollar market, was most successful. The value of the (commodity) exports of the oil-importing countries was growing rapidly, relative to the level of nominal interest rates. Indeed, real interest rates were generally negative, especially when compared to the inflation rate of the (commodity) exports of oil-importing countries. In such conditions the debtors, in this case the oil importers, were benefited, while the largesse of oil money to the oil producers was so great that they hardly noticed the erosion of the value of their savings. Meanwhile, the large international banks, who were facilitating the intermediation, were also benefiting hugely.

But the central bankers were worried, mainly because this huge, international euro-market escaped their direct control. They had been brought up on a diet of control mechanisms, such as required reserves and direct credit controls, from which the euro-market appeared to escape completely. Might the euro-market expand as a result without limit? Could uncontrolled, and perhaps uncontrollable financial flows, emanating from this market destabilise the national financial markets over which the central banks were meant to preside? It was such concerns that led to the Governors of the G10 central banks at their meetings in Basel under the auspices of the bank for International Settlements to set up their first Standing Committee, the Euro-currency Standing Committee in 197**?**.

But in the benign condition (for debtors) in the 1970s, it was not the euro-currency market which suffered a (minor) crisis but the foreign exchange market where a minor German bank, Herstatt, failed as a consequence of speculative over-trading on the foreign exchange market in 1974. In part because the bankruptcy process was mishandled, this caused the New York leg of its current foreign exchange deals to default, and dislocated the huge, and central, foreign exchange (henceforth, FX)

[72] [Put references here]

market for several days.

In view of this, and of the failure at much the same time of **???**, the central bank Governors decided that they needed to supplement the Euro-currency Standing Committee with a second committee, whose remit was to look at the prudential oversight of international commercial, and, initially, to provide an 'early warning system' (henceforth, EWS) against future international crises.

Meanwhile, a self-selected group of central bank officials in European countries, the Groupe de Contact, had been meeting to discuss the best way to supervise foreign-headquartered branches and subsidiaries, which were increasingly being established in host countries. These officials became the core members of the new Basel Committee on banking Supervision. Having successfully batted away the initial mandate to provide an EWS,[73] the BCBS reverted to its preferred task of establishing procedures for ensuring that all segments of international banks had appropriate supervisory oversight, and that the home supervisor could adequately supervise its cross-border banks as a whole. These measures became enshrined in a series of agreements, which became known as the Concordat, an exercise that took up the largest proportion of BCBS' time between 1975 and 1982.

Then in the summer of 1982 the worst international financial crisis since WWII struck, as a consequence of the Volcker regime change of October 1979. Official U.S. short-term interest rates were driven up to 20% and U.S. long rates rose to nearly 15%. As a result there was a sharp recession in the U.S. and Europe. This led to a collapse of commodity prices and exports. Those countries which had borrowed, so successfully, via the euro-dollar market in the inflationary 1970s now increasingly found themselves in trouble.

One might have expected both the borrowing countries and the international lending banks to have observed the regime change of October 1979, and to have taken steps to adjust to it. But even amongst leading financiers there is a tendency to extrapolate recent conditions into the future (especially when supported by econometric models doing precisely the same), and learning is slow. As in 2007/8, the crisis of 1982 was enlivened by a memorable quote from the CEO of Citicorp [**check source**], Walter Wriston, who stated that 'Sovereign states do not default'.

But of course they do so, at least on their foreign currency debt. In the summer of 1982 Mexico threatened to default on its foreign currency debt, closely followed by Argentina and Brazil, the MAB crisis (the story of which is told in greater length in **???**). The large international banks, notably the main New York City Centre banks had extended massive loans to MAB. Had such loans gone into default, (or even been marked to market as they would be nowadays), many, perhaps most, of these central, core banks would have become insolvent, and a massive crisis, probably much worse than 2007/8, would have ensued. In practice, central bankers around the world rallied, and led by Volcker, de Larosiere, Richardson, Leutwiler and Lamfalussy,

[73] Whenever a crisis emerges, those in authority at the top invariably call for an EWS. But such a search is, almost by definition, chimerical, since if a crisis could be predicted, it would not happen!

organised a process of international 'evergreening', whereby the international banks, alongside the IMF, lent more money to MAB and in return MAB did not default, plus forebearance whereby the same international banks were not obliged to write down their loans to MAB until they became strong enough to do so. By modern standards of transparency and mark-to-market, these policies were 'incorrect' and wrong, but, in the context of 1982/83, they worked then (see Volcker and Gyohten, *cit.*, Chapter 7).

One reason why the main U.S. banks were so fragile in 1982 was that they had progressively allowed their capital to decline, as had their competitors in other countries. So, when Congress reviewed these events, they proposed a law to tighten required capital ratios for US banks (**???**). The American banks lobbied in response to argue that this would put them at a competitive disadvantage, especially to Japanese banks and some publicly-owned banks in France and elsewhere, which operated with much lower capital requirements. So Volcker was given a mandate to go to the G10 Governors BIS meeting and there to put pressure on the BCBS to agree on harmonised international capital adequacy requirements, CARs, for large, international banks.

[Figure 3.6]

The BCBS already was working, though in a somewhat desultory manner, along such lines. Besides the inherent, and severe, difficulties of deciding both on the appropriate definition(s) of bank capital, and of how a CAR should be structured (problems that of course remain), the BCBS was constrained by the fact that it was only a quasi-official advisory group. It had no power at all to dictate to the authorities in any sovereign country, and therefore felt that it could only provide recommendations where these were unanimously supported by (the BCBS representatives of) all its member countries. But most member countries had previously established for themselves some internal working arrangements for CARs, and few were keen to accept some different set of rules, just to achieve harmonisation.

As is well known, this Gordian knot was severed by the U.S., under Volcker and Corrigan, and the U.K., under Leigh-Pemberton and Quinn, coming together to agree an outline set of CARs in autumn 1987, and then pressurising the Japanese broadly to go along with them. This gave the U.S./U.K. a credible threat that they might exclude international banks from other countries from their markets unless they adopted these rules. But the U.S./U.K. negotiators had gone behind the back of the BCBS, and indeed also of its bank of England Chairman, Peter Cooke, who was intentionally kept 'out of the loop'. By international standards the U.S./U.K. had behaved badly, especially the U.K., whose behaviour was not *communautaire*. So, the various influences led towards a compromise, whereby the final agreement incorporated some of the U.S./U.K. proposals and some more palatable to the Europeans. In particular the U.S. abandoned its early preference for a simpler leverage ratio, in favour of the European-designed 'risk-weighted asset' (RWA) approach, while Germany (finally, after much pressure) agreed to move from a concentration on pure, tangible core equity, to a wider two tier approach, allowing more space for a limited amount

of subordinated debt and some forms of 'hybrid' capital, such as preference shares.[74] Thus, after much discussion in the course of 1987, the Basel Capital Accord, or Basel I as it is now known, was born in 1988.

The BCBS was also engaged on a similar exercise to try to reach an accord on harmonised requirements for liquidity. Like capital, liquid asset ratios had been in free fall for some long time. The advent of large whole-sale money markets, the CD market, interbank markets, etc., plus the pressures of international competition, encouraged banks to replace asset liquidity, (holdings of easily saleable, usually public sector, but low-yielding debt), by funding liquidity, i.e. access to wholesale markets. The idea was that, so long as a commercial bank was adequately capitalised, it could always garner liquidity by accessing the large and efficient wholesale markets.

The BCBS did not entirely buy this latter argument, but nevertheless failed to reach agreement. What is a liquid asset in any monetary regime depends in some large part on what the central bank there will discount or accept as collateral, and central bank practices varied. There was no external political pressure to bang heads together; the BCBS was exhausted by its travails on the Basel Accord on CARs; this Accord would of itself, by raising capital, enhance the robustness of banks accessing wholesale markets; and anyhow liquidity crises could be expected to be very rare, 'once in a blue moon'. So nothing was agreed in the BCBS, and liquidity ratios continued their precipitate drop, as in the case of the UK.

[Figure 3.7]

Unlike liquidity ratios, the BCBS 1988 Accord did reverse the decline in capital ratios. Indeed, as they became phased in during the early 1990s, this may have played some slight role in some cases in deepening the recession of 1991/92.[75] There were a variety of reasons for this recession, including the mishandling of German reunification, already mentioned in Section **??**, a resurgence of inflation, following a lowering of interest rates after the stock-market crash of October 1987, a bubble in housing prices in some areas, notably North East U.S. and U.K., and, perhaps, the introduction of the Basel Accord. Anyhow, interest rates were raised sharply in many countries in 1990/91, and a recession followed. It was to be the last serious recession in most countries until 2008/9.

4 The Nice Years, 1993-2006

There was faster growth amongst developed countries in the earlier decades after WWII than in this period, though in view of the resurgence of China and India it is doubtful whether World per capita growth has ever been greater than in than in 1993-2006. Inflation had, on average, been lower under the Gold Standard and in

[74] Interestingly the events of 2007/9 have tended to underline the virtues both of leverage ratios and of a focus on tangible core equity, (TCE).

[75] [Put references here]

the interwar years. Unemployment, though generally falling, remained stubbornly above the levels achieved from 1945 until 1973. Instead, what was remarkable, at least in hindsight, was the stability of these years. In most developed countries, the standard deviation of most macro-variables—first and foremost, inflation and output growth, and, to a lesser extent, nominal interest rates (see Figure 1.1)—fell to remarkably low levels, a phenomenon which Stock and Watson (2003) christened as the Great Moderation. (To be precise, the international Great Moderation started around mid-1980s.[76] We discuss the Great Moderation phenomenon within this Section, devoted to the 'nice years', for ease of exposition.) In the United Kingdom, every single quarter in these years exhibited steady positive growth, so much so that Gordon Brown, hubristically, claimed to have abolished boom and bust.[77] In the United States there was a slight recession from March 2001 to November 2001[78] following the NASDAQ/Tech bubble, but this was one of the mildest on record (Tables 4.1; 4.2).

By this measuring rod this last period was clearly the best, though it was not so in terms of average growth or inflation (Table 4.3).

These years did not, however, seem so calm to those in charge of monetary policy. There were recurring shocks. These included, in particular,

- the South East Asian crisis in 1997/98, culminating in the Russian default and the speculative attack on Hong Kong in August 1998, followed by the collapse and rescue of the hedge fund Long Term Capital Management (LTCM) in September and indigestion in the US. Treasury bond market;
- the 9/11 terrorist attack, in September 2001; and
- the Nasdaq/Tech bubble and bust between 1999 and 2002.

In each case the problem migrated to U.S. financial markets, even if, as in the South-East Asian crisis, it originated elsewhere; and in each case the disturbance was resolved by a, relatively rapid, reaction by the Fed in cutting interest rates, to a point where market confidence and stability returned. There were, moreover, other more narrowly American occasions which the Fed, and Alan Greenspan in particular, handled with aplomb, notably the inflation scare in the bond market in 1994 and the uplift in productivity in the mid 1990s which allowed the U.S. to grow faster with less inflation. Greenspan had divined this before most of his colleagues on the FOMC, and his successful opposition to any pre-emptive interest rate increase then cemented his reputation as a prodigy.

[76] For the United States, Kim and Nelson (1999) and McConnell and Perez-Quiros (2000) identified a structural break in the volatility of reduced-form innovations to U.S. real GDP growth in the first quarter of 1984, with a dramatic volatility decrease over the most recent period.

[77] See footnote 4.

[78] See at: http://www.nber.org/cycles/cyclesmain.html, detailing the U.S. business-cycle expansions and contractions as dated by the NBER Business Cycle Dating Committee .

Success is always likely to spread its lustre on those in charge at the time, and the reputation of many other leading central bankers around the world reflected this. But such widespread success is more often the result of an appropriate procedure, and the accepted wisdom was that, after the period of experimentation in 1979-92, a correct regime of monetary policy had now become established. This was that (operationally) independent central banks should use their (main) instrument of varying short-term policy interest rates to hit an inflation target over the medium term, whilst allowing their exchange rate to float (relatively) freely. Whilst there were differences in presentation, especially in the U.S., and in the parameters chosen, the principles (e.g. as established by John Taylor) were generally followed everywhere.

The inflation indices, however, focussed primarily on goods and services prices, sometimes on a narrower set of core prices, whereas the disturbances, as noted above, primarily occurred in asset markets. This caused many to query whether either the chosen inflation index, or the monetary policy adopted, should somehow respond to asset prices. This argument was rejected, notably by Greenspan himself, on a number of grounds, such as:[79]

- it would be difficult to discern when asset prices needed correction;
- leaning against asset price bubbles could destabilise the real economy, and hence be politically unpopular, without doing enough to have much effect on the bubble itself; and
- when the bubble burst it could (usually) be mopped up, without undue difficulty, by sufficiently aggressive cuts in interest rates.

After the experiences of these years, this latter claim gained credibility. Investors and financiers came to believe that the monetary authorities could, and would, protect financial markets from severe downturns and crises, *via* the Greenspan 'put'.[80] Whether or not the Fed behaved asymmetrically in response to asset market developments,[81] remains a contentious issue, but the belief grew that, by the same token as central banks stabilised inflation, so they could, by acceptable adjustments of that same policy, stabilise asset markets. Risk premia fell (see Figure 4.1).

Thus the general view, prior to August 2007, was that central banks had found a recipe for success. They had probably never ranked higher in the public's esteem. But while it is difficult to fault their actions, it is also arguable that the underlying conjuncture in these years was unusually favourable. There are two main factors that may have caused this. The first is the entry of China and India into the global trading system; the second is the upsurge of productivity, probably related to Information Technology. Both had the effect of weakening the bargaining strength of labour and

[79] [Put references here; look for Greenspan speeches at the Fed website]
[80] [Reference M. Miller]
[81] [Donald Kohn vs ???]

of raising returns to capital. With a weaker, slower growth of wages, and declining prices of manufactured goods, the maintenance of low inflation and steady growth was not so difficult, though it also brought with it increasing income and wealth inequalities, and was a factor in restraining consumption in developing economies.

If the achievement of macro stability had been difficult, one might have expected to see the evidence in sharp fluctuations in official interest rates (to offset any large shocks). But in practice neither nominal, nor real, interest rates varied much in these years, (Table 4.4).

If interest rates did not have to vary much to maintain stable outcomes, the implication is that the shocks that occurred must have been relatively mild. But this is no more than indirect evidence about a matter that remains both contentious and of considerable interest. So we now turn to the issue of whether the macroeconomic stability associated with the Great Moderation was due to good luck, better macroeconomic management, or a combination of both.

4.1 The Great Moderation: good policy or good luck?

Studies on the causes of the Great Moderation[82] can be classified within three major groups, associated with the 'good luck', 'good policy', and 'structural change' explanations. The first group of studies suggests that the Great Moderation has been simply due to the lower volatility of fundamental shocks over the most recent period. The second group maintains, instead, that improved monetary policy played a crucial role. The third group points towards changes in the structure of the economy independent from changes in the conduct of monetary policy. For reasons which will become apparent, our discussion will proceed from a *methodological* perspective, starting with the results produced by the structural VAR literature and ending up with those produced by the literature based on estimated DSGE models. Two key themes will emerge from our discussion. First, the issues involved in a proper assessment of the key underlying causes of the Great Moderation are significantly more subtle than it was originally envisaged by the 'first wave' of studies based on structural VAR methods, as they often appear to boil down to fundamental issues in macroeconomic analysis, in particular the (in)ability of time-series methods to correctly identify the impact of policy changes within the underlying structural model of the economy (e.g., as described in a macroeconomic DSGE model). Second, the literature is still far from settling down on a widely agreed account of the causes of the Great Moderation.

[82] The literature on the Great Moderation started with Kim and Nelson (1999) and McConnell and Perez-Quiros (2000), who first independently documented a break in the innovation variance of U.S. output growth in the first quarter of 1984, with a significant decline in the latter period.

4.1.1 Evidence based on structural VAR methods

Structural VAR studies of the Great Moderation—see in particular Stock and Watson (2002), Primiceri (2005), Sims and Zha (2006), and Gambetti, Pappa, and Canova (2006)—have produced three types of evidence:

(1) the volatilities of VARs' residuals exhibit subtantial declines around the first half of the 1980s.

(2) Impulse-reponse functions to monetary policy shocks do not appear to have been, over the most recent period, significantly different from what they had been over previous years.

(3) Counterfactual simulations in which the estimated structural monetary rule associated with (say) Alan Greeenspan is imposed over the entire post-WWII sample period point towards limited differences in macroeconomic outcomes.

(1) has been traditionally interpreted, within the SVAR literature, as evidence of a decline in the volatilities of *structural* shocks over the most recent period, whereas (2) and (3) have been interpreted as evidence of a comparatively minor role played by monetary policy in fostering the greater stability of the most recent period.

A simple illustration for the United States In what follows we will work with the following time-varying parameters VAR(p) model:

$$Y_t = B_{0,t} + B_{1,t}Y_{t-1} + ... + B_{p,t}Y_{t-p} + \epsilon_t \equiv X_t'\theta_t + \epsilon_t \tag{4}$$

where the notation is obvious, and Y_t is defined as $Y_t \equiv [r_t,\ \pi_t, y_t, m_t]'$, with r_t, π_t, y_t, m_t being the Federal Funds rate, GDP deflator inflation, and the rates of growth of real GDP and M2, respectively (For a description of the data and of the sample periods, see Appendix A). For reasons of comparability with other papers in the literature[83] we set the lag order to p=2. Following, e.g., Cogley and Sargent (2002), Cogley and Sargent (2005) and Primiceri (2005), the VAR's time-varying parameters, collected in the vector θ_t, are postulated to evolve according to

$$p(\theta_t \mid \theta_{t-1},\, Q) = I(\theta_t)\ f(\theta_t \mid \theta_{t-1},\, Q) \tag{5}$$

with $I(\theta_t)$ being an indicator function rejecting unstable draws—thus enforcing a stationarity constraint on the VAR—and with $f(\theta_t \mid \theta_{t-1},\, Q)$ given by

$$\theta_t = \theta_{t-1} + \eta_t \tag{6}$$

with $\eta_t \sim N(0,\, Q)$. The VAR's reduced-form innovations in (4) are postulated to be zero-mean normally distributed, with time-varying covariance matrix Ω_t which, following established practice, we factor as

$$\text{Var}(\epsilon_t) \equiv \Omega_t = A_t^{-1} H_t (A_t^{-1})' \tag{7}$$

[83] See e.g. Cogley and Sargent (2002), Cogley and Sargent (2005), Primiceri (2005), and Gambetti, Pappa, and Canova (2006).

The time-varying matrices H_t and A_t are defined as:

$$H_t \equiv \begin{bmatrix} h_{1,t} & 0 & 0 & 0 \\ 0 & h_{2,t} & 0 & 0 \\ 0 & 0 & h_{3,t} & 0 \\ 0 & 0 & 0 & h_{4,t} \end{bmatrix} \qquad A_t \equiv \begin{bmatrix} 1 & 0 & 0 & 0 \\ \alpha_{21,t} & 1 & 0 & 0 \\ \alpha_{31,t} & \alpha_{32,t} & 1 & 0 \\ \alpha_{41,t} & \alpha_{42,t} & \alpha_{43,t} & 1 \end{bmatrix} \tag{8}$$

with the $h_{i,t}$ evolving as geometric random walks,

$$\ln h_{i,t} = \ln h_{i,t-1} + \nu_{i,t} \tag{9}$$

For future reference, we define $h_t \equiv [h_{1,t},\, h_{2,t}, h_{3,t}, h_{4,t}]'$. Following Primiceri (2005), we postulate the non-zero and non-one elements of the matrix A_t—which we collect in the vector $\alpha_t \equiv [\alpha_{21,t},\, \alpha_{31,t},\, ...,\, \alpha_{43,t}]'$—to evolve as driftless random walks,

$$\alpha_t = \alpha_{t-1} + \tau_t \ , \tag{10}$$

and we assume the vector $[u_t',\, \eta_t',\, \tau_t',\, \nu_t']'$ to be distributed as

$$\begin{bmatrix} u_t \\ \eta_t \\ \tau_t \\ \nu_t \end{bmatrix} \sim N\left(0, V\right), \text{ with } V = \begin{bmatrix} I_4 & 0 & 0 & 0 \\ 0 & Q & 0 & 0 \\ 0 & 0 & S & 0 \\ 0 & 0 & 0 & Z \end{bmatrix} \text{ and } Z = \begin{bmatrix} \sigma_1^2 & 0 & 0 & 0 \\ 0 & \sigma_2^2 & 0 & 0 \\ 0 & 0 & \sigma_3^2 & 0 \\ 0 & 0 & 0 & \sigma_4^2 \end{bmatrix} \tag{11}$$

where u_t is such that $\epsilon_t \equiv A_t^{-1} H_t^{\frac{1}{2}} u_t$. As discussed in Primiceri (2005), there are two justifications for assuming a block-diagonal structure for V. First, parsimony, as the model is already quite heavily parameterized. Second, 'allowing for a completely generic correlation structure among different sources of uncertainty would preclude any structural interpretation of the innovations'.[84] Finally, following, again, Primiceri (2005) we adopt the additional simplifying assumption of postulating a block-diagonal structure for S, too—namely

$$S \equiv \text{Var}\left(\tau_t\right) = \text{Var}\left(\tau_t\right) = \begin{bmatrix} S_1 & 0_{1\times 2} & 0_{1\times 3} \\ 0_{2\times 1} & S_2 & 0_{2\times 3} \\ 0_{3\times 1} & 0_{3\times 2} & S_3 \end{bmatrix} \tag{12}$$

with $S_1 \equiv \text{Var}(\tau_{21,t})$, $S_2 \equiv \text{Var}([\tau_{31,t}, \tau_{32,t}]')$, and $S_3 \equiv \text{Var}([\tau_{41,t}, \tau_{32,t}, \tau_{43,t}]')$, thus implying that the non-zero and non-one elements of A_t belonging to different rows evolve independently. As discussed in Primiceri (2005, Appendix A.2), this assumption drastically simplifies inference, as it allows to do Gibbs sampling on the non-zero and non-one elements of A_t equation by equation.

We estimate (4)-(12) *via* Bayesian methods. Appendix B discusses our choices for the priors, the Markov-Chain Monte Carlo algorithm we use to simulate the

[84] Primiceri (2005, pp. 6-7).

posterior distribution of the hyperparameters and the states conditional on the data, and the method we use to check for convergence of the Markov chain to the ergodic distribution. The methodology is the same used in Benati (2008a), and combines elements of Cogley and Sargent (2005) and Primiceri (2005).

Evolving macroeconomic volatility Figure 4.1 illustrates the first kind of evidence produced by the VAR literature. The very first panel on the left shows the median of the time-varying distribution of $\ln|\Omega_t|$, which, following Cogley and Sargent (2005),[85] we interpret as a measure of the total amount of noise 'hitting the system' at each point in time—together with the 16th and 84th percentiles. $\ln|\Omega_t|$ is estimated to have significantly increased around the time of the Great Inflation episode,[86] reaching a historical peak in 1980:2; to have dramatically decreased under the Chairmanship of Paul Volcker, and during the first half of Alan Greenspan's tenure; to have increased around the time of the 2000-2001 recession, thus testifying to the marked increase in macroeconomic turbulence associated with the unwinding of the dotcom bubble; and to have decreased ever since, reaching (based on median estimates) a historical low towarsd the end of the sample. Turning to the other components of Ω_t, the remaining four panels show the evolution of the standard deviations of the VAR's residuals, in percentage points. For all four series, the volatility of reduced-form shocks reached a peak around the time of the Volcker disinflation. This is especially clear for the Federal Funds rate, which exhibited a dramatic spike corresponding to the FED's temporary adoption of a policy of targeting non-borrowed reserves, but it is equally apparent, although in a less dramatic fashion, for the other three series. We now turn to the other two types of evidence produced by the VAR literature.

Evolving uncertainty Figure 4.2 illustrates a second key feature of the Great Moderation, by showing the evolution of macroeconomic *uncertainty* for the U.S., the Euro area, Japan, the U.K., Canada, and Australia. Specifically, the figure shows changes over time in the standard deviations (in basis points) of the distributions of k-step-ahead forecasts for the four series of interest (for k = 1, 2, ..., 8 quarters), a simple measure of the extent of uncertainty associated with future projections.[87]

[85] In turn, they were following Whittle (1953)—see Cogley and Sargent (2005, Section 3.5).

[86] Interestingly, the top-left panel of Figure 2 clearly suggests that the total prediction variance started increasing *before* the collapse of Bretton Woods, in August 1971. There are two possible—and not mutually exclusive—interpretations of this result. First, from a strictly technical point of view, estimates of the states based on Gibbs sampling are, by construction, two-sided, and in the case of sharp breaks they therefore inevitably tend to 'mix the future with the past', thus giving the impression that the change took place before it actually did. Because of this, these results are *not incompatible* with the notion that the increase in the total prediction variance actually took place after August 1971. A second possibility is that these results are *precisely* capturing the macroeconomic turbulence that ultimately undid Bretton Woods—e.g. the large fiscal shocks associated with the financing of the Vietnam war.

[87] In order to make the figure easier to read, we eliminated high-frequency noise from the objects shown therein *via* the Christiano and Fitzgerald (2003) filter. Specifically, the components we

Projections have been computed by stochastically simulating the VAR into the future 1,000 times.[88] Due to the computational intensity involved with estimating the time-varying VAR, the present exercise has been performed based on the two-sided output of the Gibbs sampler conditional on the full sample, so that these k-step ahead projections should only be regarded as approximations to the authentic out-of-sample objects that would result from a proper recursive estimation.

Several findings clearly emerge from the figure. In particular, *first*, for all countries, and for both inflation and output growth, the extent of macroeconomic uncertainty exhibits a clear peak, at all horizons, around the time of the Great Inflation, and a significant decrease thereafter.[89] *Second*, the most recent period—characterised by the deep recession associated with the financial crisis—exhibits, in several cases, an increase in macroeconomic uncertainty. This is especially clear, e.g., for output growth for the U.K. and Canada, and for inflation for Canada, Australia, and Japan. The remarkable decrease in macroeconomic uncertainty at all horizons associated with the Great Moderation offers a simple and compelling explanation for the dramatic compression in risk spreads which characterised especially the years immediately before the onset of the financial crisis. With the world economy so remarkably stable—maybe, because central bankers had finally found the Philososopher's Stone of monetary policy ...—and with the near-disappearance of macroeconomic uncertainty across the board, a dangerous notion that the world was a *much safer* place than previously thought progressively spread around, leading to a fall in risk premia across the board.

Structural identification In the spirit of Primiceri (2005) and Gambetti, Pappa, and Canova (2006), we then impose, on the estimated time-varying VAR, identifying restrictions on a period-by-period basis. Specifically, we identify four structural shocks—a monetary policy shock (ϵ_t^M), a supply shock (ϵ_t^S), a demand non-policy shock (ϵ_t^D), and a money demand shock (ϵ_t^{MD})—by imposing the sign restrictions reported in the following Table on the contemporaneous impacts of the structural shocks on the endogenous variable (it can be trivially shown that such restrictions are sufficient to uniquely identify the four shocks). We compute the time-varying structural impact matrix, $A_{0,t}$, *via* the procedure recently proposed by Rubio-Ramirez, Waggoner, and Zha (2005).[90]

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eliminated are those with a frequency of obscillation faster than six quarters.

[88] Specifically, for every quarter, and for each of the 1,000 simulations, we start by sampling the current state of the economy from the Gibbs sampler's output for that quarter, by drawing a random number from a uniform distribution defined over [1; 1,000]. Conditional on this draw for the current state of the economy at t, we then simulate the VAR into the future.

[89] This is less clear for the Euro area because the sample period shown in the figure starts in the late 1970s, due to the need of using the first eight years of data to compute the Bayesian priors.

[90] See at http://home.earthlink.net/~tzha02/ProgramCode/SRestrictRWZalg.m. Specifically, let $\Omega_t = P_t D_t P_t'$ be the eigenvalue-eigenvector decomposition of the VAR's time-varying covariance matrix Ω_t, and let $\tilde{A}_{0,t} \equiv P_t D_t^{\frac{1}{2}}$. We draw an $N \times N$ matrix, K, from the $N(0, 1)$ distribution, we

	Shock:			
Variable:	ϵ_t^M	ϵ_t^D	ϵ_t^S	ϵ_t^{MD}
Federal Funds rate	+	+	?	+
inflation	–	+	–	–
output growth	–	+	+	–
M2 growth	–	+	?	+
? = left unconstrained				

Monetary policy counterfactuals Figure 4.3 shows results from 1,000 counterfactual simulations in which we have imposed, over the entire sample period, the structural monetary rules identified for the Chairmanships of Paul Volcker and Alan Greenspan.[91] Specifically, the figures shows, for each of the four series, the medians of the distributions of the difference between the counterfactual paths and the actual series, together with the 16th and 84th percentiles. Starting with the top row, imposing Paul Volcker over the entire sample period produces two main results. First, virtually no difference, or very little difference, between actual and counterfactual outcomes over the period following the end of the Volcker disinflation. Second, as for the years up to the end of the Volcker disinflation, it generates counterfactual paths for inflation, output growth, and M2 growth systematically below actual historical ones. (It has to be stressed, however, that in the case of inflation the difference is not enormous, reaching a maximum of about minus three percentage points in the second half of the 1970s, when actual inflation was moving towards ten per cent). Such disinflationary impact is achieved *via* marginally higher interest rates over the first half of the sample, thus suggesting that reputational effects are crucial in determining the result here.

Turning to the bottom row, 'bringing Alan Greenspan back in time' would have had little impact on inflation before the collapse of Bretton Woods; it would have had no discernible effect after 1983-1984; and, most notably, it would have had a prolonged discernible impact—equal, however, to at most three and a half percentage points—between 1977 and 1981-1982, when inflation fluctuated between 5 and 11.6 per cent.

take the QR decomposition of K—that is, we compute matrices Q and R such that $K{=}Q \cdot R$—and we compute the time-varying structural impact matrix as $A_{0,t}{=}\tilde{A}_{0,t} \cdot Q'$. If the draw satisfies the restrictions we keep it, otherwise we discard it and we keep drawing until the restrictions are satisfied, as in the Rubio-Waggoner-Zha code `SRestrictRWZalg.m` which implements their algorithm.

[91] Specifically, for each simulation $j{=}1, 2, ..., N$, at each quarter $t{=}p{+}1, p{+}2, ..., T$ we draw three random numbers, τ, indexing the quarter of the Chairmanship from which we draw the elements of the structural monetary rule; and κ_t and κ_τ, indexing the iterations of the Gibbs sampler at times t and, respectively, τ from which we draw the state of the economy. (All three numbers are defined over appropriate uniform distributions.) We then take all of the elements of the monetary rule from iteration κ_τ of the Gibbs sampler for quarter τ, while we take everything else from iteration κ_t for quarter t. We start each counterfactual simulation conditional on the first p actual historical values of the vector Y_t.

As the figure shows, such a minor stabilising impact on inflation would have been achieved *via* marginally higher interest rates—up to two additional percentage points, in 1975-1977—and subsequently lower output and M2 growth during the second half of the 1970s. As for output growth, in particular, whereas Volcker would have achieved a maximum impact equal to about minus 3.8 per cent in 1975, the corresponding impact of a countefactual Greenspan Chairmanship would have been beyond minus 6 per cent.

Impulse-response functions to a monetary policy shock Finally, Figure 4.4 plots, for the four series, the time-varying median generalised impulse-response functions (henceforth, IRFs) to a 25 basis points monetary policy shock. Generalised IRFs have been computed *via* the Monte Carlo integration procedure described in Appendix C, which allows to effectively tackle the uncertainty originating from future time-variation in the VAR's structure. Due to the computational intensity of such a procedure, IRFs have been computed only every four quarters. Overall, the figure does not point towards dramatic differences between the response of the economy—and in particular, of inflation and output growth—to a monetary policy shock during the 1970s and in subsequent years, which is traditionally interpreted as evidence in favor of the notion that monetary policy did not change significantly over the post-WWII era, and therefore can't have played a major role, first, in causing the Great Inflation, and then in fostering the Great Moderation.

But how reliable is the evidence produced by VAR methods? We start by reviewing De Long's (2003) and Bernanke's (2004) critiques of the traditional interpretation of the decrease in the innovation variance of VAR residuals, and we then turn to the issue of the reliability of SVAR-based policy counterfactuals, and to a DSGE-based perspective on the results produced by the structural VAR literature.

Conceptual critiques of the traditional interpretation of the decrease in the innovation variance of VAR residuals Skepticism of the standard interpretation of the decrease in the innovation variance of VAR residuals was first expressed by DeLong (2003) in his comment on Stock and Watson (2003):

> '[I]t is not clear at all that the actual [i.e., structural] shocks to the economy have been smaller since 1984. Before 1984 we have the Vietnam war, the oil shocks of 1973 and 1979, etc.. Since 1984 we have had the stock market crash of 1987, the dot.com bubble and then the Nasdaq crash, the extraordinary near panic of 1998 [and] September 11 [. . .]. Doesn't the swift reaction of the FED to 1987, 1998, to 2001–swift reactions that find no place in Stock andWatson's measure of "policy"–play a role in reducing the size of the business cycle?'

De Long hits upon a fundamental issue: by itself, the fact that the economy exhibits little variation does not allow to discriminate between two rival explanations:

(1) the structural shocks have become smaller, and (2) the central bank has become better at responding to shocks. Indeed, a key theme which has been repeatedly stressed within the so-called 'narrative approach' is that, over the post-WWII era, central banks 'have become progressively better at doing their job'. There are several reasons for this: the discarding of flawed approaches to monetary policymaking, a better understanding of the workings of the economy, etc.. Whatever the reason, such improvements in monetary policymaking would likely be interpreted, within the VAR framework, as a reduction in the volatilities of shocks thus giving the illusion of 'good luck'.

The difficulty of interpreting the results produced by the VAR literature was further discussed by Bernanke, who, in a speech on the Great Moderation in the U.S.,[92] discussed several reasons why VAR methods might confuse the impact of better monetary policy for a reduction in the volatility of non-policy shocks. In particular, he stressed how

> '[...] changes in monetary policy could conceivably affect the size and frequency of shocks hitting the economy, at least as an econometrician would measure those shocks. [...] Seemingly unexplained or autonomous movements in wages and prices [...], which analysts would have interpreted as shocks to wage and price equations, may in fact have been the result of earlier monetary policy actions, or (more subtly) of monetary policy actions expected by wage and price-setters to take place in the future. [...] [C]hanges in inflation expectations, which are ultimately the product of the monetary policy regime, can be confused with truly exogenous shocks in conventional econometric analyses.'

The last sentence, in particular, points towards a different theme from the one stressed by De Long, i.e. the stabilising (destabilising) impact of good (bad) monetary policy on expectations, and therefore, via this channel, on actual macroeconomic outcome.

We now turn to the issue of the reliability of SVAR-based policy counterfactuals.

The British experience: from 'inflation as a non-monetary phenomenon' to the inflation targeting regime In this respect the British experience is especially important, as historical, 'narrative' evidence for the United Kingdom is significantly much sharper than for other countries, first and foremost the United States. In their extensive analysis of the broad intellectual climate surrounding monetary policymaking in the United Kingdom during the 1960s and 1970s, Nelson and Nikolov (2004) point out that

> [m]onetary policy was not seen as essential for inflation control; the latter, instead, was largely delegated to incomes policy (wage and price controls). [...]

[92] See Bernanke (2004).

> Essentially, UK policymakers viewed monetary policy as disconnected from inflation for two reasons. First, inflation was perceived as largely driven by factors other than the output gap; secondly, policymakers were highly sceptical about the ability of monetary policy to affect aggregate demand or the output gap appreciably. [This] led to a combination of easy monetary policy and attempts to control inflation through other devices, and contributed heavily to the breakout of inflation in the 1960s and 1970s.

Similar views have been expressed by the Governor of the *bank of England*, Mervyn King, in his reflections on the evolution of macroeconomic thinking and monetary policymaking in the United Kingdom since the 1960s—see King (2005).

> From the end of the second world war until the mid to late 1970s, the majority view of [U.K.] academic economists and policy-makers alike was that monetary policy had rather little to do with inflation, and was largely ineffective as an instrument of demand management. [...] Fortunately, the theory and practice of monetary policy in the UK have changed out of all recognition in the past twenty-five years.

The dramatic changes in U.K. macroeconomic thinking and monetary policymaking since the beginning of the 1960s—from inflation being regarded as an essentially 'non-monetary phenomenon', to the introduction of the inflation targeting regime—naturally suggest that the evolution of post-WWII U.K. inflation has been shaped, to a significant, or even dominant extent, by changes in the nature of the monetary regime, rather than sheer 'luck'. Quite stunningly, however, this is not what structural VAR methods suggest: as documented by Benati (2008a), the very same policy counterfactuals we previously performed for the United States[93] suggest that U.K. post-WWII macroeconomic dynamics has been shaped, to a dominant extent, by luck, with only a minimal role played by improved monetary policy.

In the next subsection we discuss a further bizarre result produced by standard VAR methodology: when we apply the very same 'off-the-shelf' methodology which we have been using up until now to the alternative counterfactual of 'bringing the Bundesbank to the United States', we obtain the result that the Great Inflation is still there.

Results from a quasi-natural experiment: would the Bundesbank have prevented the Great Inflation in the United States?[94] The methodology we use is exactly the same we used to 'bring Volcker and Greenspan back in the 1970s', with the only difference that, due to the crucial role played by the German nominal

[93] More generally, the standard structural VAR model we use herein is exactly the same used in Benati (2008a).

[94] This section is based on Benati (2009b).

exchange rate in countering inflationary impulses originating on world commodity markets (see our discussion in Section 2.1.3), we add the rate of change of the NEER to the Y_t vector in (4), so that $Y_t \equiv [r_t,\ \pi_t,\ y_t,\ m_t,\ neer_t]'$, with r_t, π_t, y_t, m_t, and $neer_t$ being a short-term interest rate (specifically, the Federal Funds rate for the United States, and a call money rate for Germany), GDP deflator inflation, and the rates of change of real GDP, nominal M2, and the nominal effective exchange rate (henceforth, NEER), respectively. We then consider the following set of sign restrictions, with the first four shocks being the same as before, and an additional shock, ϵ_t^{NEER}, which can be given several alternative interpretations (for example, it might reflect either a shock to the foreign exchange risk premium, or the impact of a foreign monetary policy shock).

	Shock:				
Variable:	ϵ_t^M	ϵ_t^D	ϵ_t^S	ϵ_t^{MD}	ϵ_t^{NEER}
short rate	+	+	?	+	−
inflation	−	+	−	−	−
output growth	−	+	+	−	−
money growth	−	+	?	+	?
rate of change of NEER	+	+	+	+	+

Figure 4.5 shows the results from the counterfactual simulations in which we 'bring the Bundesbank to the United States', by imposing the structural monetary policy rule estimated for Germany's central bank for the period 1973:2-1990:1 onto the estimated structural VAR for the U.S. economy over the entire sample period.[95] Specifically, the Figure shows, for all the series used in the VAR, the actual historical values together with the medians and the 16th and the 84th percentiles of the distributions of the simulated counterfactuals series.[96] Focusing on inflation, the difference between the actual and the counterfactual inflation series during the Great Inflation episode is, overall, very modest, which implies that, according to the structural VAR, the Bundesbank would *not* have been able to prevent the Great Inflation in the United States.[97] How can we make sense of the notion that the Bundesbank—which burnished its reputation as a hard-nosed, hard-money central bank by preventing the Great Inflation in Germany—would have been unable to deliver an analogous performance had it been put in charge of U.S. monetary policy? This result—which, it is

[95] The reason for focusing on the period following 1973:1 is that only in March 1973 the West German government relieved the *Bundesbank* of its obligation to defend the parity with the U.S. dollar, thus allowing it to fully pursue a counter-inflationary policy without the impedements coming from such external constraint.

[96] In order to make the figure easier to read, we show annual—rather than quarter-on-quarter annualised—rates of growth.

[97] Analogous results for the United Kingdom are not shown here uniquely for reasons of space, but they are available upon request. The methodology we used is identical to the one we just discussed for the U.S., and the key result is that, according to the SVAR-based policy counterfactual, the Bundesbank would *not* have been able to prevent the Great Inflation in the United Kingdom.

important to stress, has been produced *via* 'off-the-shelf' structural VAR methods—is one which the vast majority of macroeconomists would regard as extremely hard to believe,[98] and, in our view, it raises serious questions on the very reliability of SVAR-based policy counterfactuals.

A key point to stress here is that the *reliability* of policy counterfactuals based on estimated structural VARs has never been demonstrated in any way, and it has rather always been assumed. Quite obviously, the only way to rigorously assess the reliability of SVAR-based policy counterfactuals is to postulate a specific (DSGE) model, and then to explore to which extent SVAR methods can correctly capture the impact of changes in the Taylor rule within the model. The next subsection reports results from two such experiments.

Interpreting the evidence produced by structural VARs: A DSGE perspective Benati and Surico (2009) take as data-generation process a standard New Keynesian model in which the *only* source of changes across regimes is the move from passive to active monetary policy (i.e. from indeterminacy to determinacy). They then show that

- the shift in the systematic component of monetary policy associated with the move from indeterminacy to determinacy is *sufficient* to generate, *in population*, (i) decreases in the innovation variances for all series, and (ii) decreases in the variances of inflation and the output gap, and without any need of sunspot shocks.[99]

- Estimated impulse-response functions to a monetary policy shock exhibit little change across regimes.

- Policy counterfactuals based on the theoretical structural VAR representations of the model under the two regimes fail to capture the truth. In particular, substituting the VAR's structural monetary rule corresponding to the indeterminacy regime into the VAR for the determinacy regime causes a volatility *decrease*—rather than an increase—for all series.

[98] The notion that the Bundesbank's monetary policy is *the* key reason why Germany was spared the Great Inflation is widespread within both academia and central banks. One who wanted to play Devil's Advocate might dismiss the position of Bundesbanker *par excellence* such as Otmar Issing (2005). Issing's position, however, is widely shared even within the Anglo-Saxon world. Tim Besley (2008), for example, pointed out how '[i]n the 1970s and 80s there were few central banks whose policy responses to inflation provided a sufficient tightening of policy in the face of inflation to anchor public beliefs around low and stable inflation. [...] [A]n exception to the general picture was the Bundesbank which kept stable and positive real interest rates over this period with the result that German inflation remained low and stable even though it was subject to the same international cost shocks as the other countries [...].'

[99] With sunspot shocks, the estimated model exhibits decreases in both variances and innovation variances in population when moving from indeterminacy to determinacy, thus replicating the key features of the Great Moderation.

The explanation for the first result is straightforward, as it is a simple consequence of the Lucas (1976) critique.[100] The second result originates from the fact that there is no clear-cut, one-to-one mapping between changes in the systematic component of monetary policy and changes in the IRFs to a monetary policy shock, so that it is possible to construct plausible examples in which policy can change even significantly without much of a change in the IRFs (on this, see also the discussion in Canova (2007)). Finally, the third result originates from the fact that, in general, there is a disconnect between two alternative notions of (monetary) policy counterfactuals, that is

- the *authentic* policy counterfactual—namely, the one which is performed by changing the monetary policy (e.g., Taylor) rule within the underlying structural (e.g., DSGE) model of the economy—and
- the *SVAR-based* policy counterfactual—namely, the one which is performed by changing the interest rate equation within the theoretical structural VAR representation which is implied by the very same underlying structural model of the economy.

Conceptually, consider two sets of parameters for the Taylor rule:[101]

$$\begin{aligned} \text{Taylor}^1 &\equiv [\rho^1,\, \phi_\pi^1,\, \phi_y^1]' \\ \text{Taylor}^2 &\equiv [\rho^2,\, \phi_\pi^2,\, \phi_y^2]' \end{aligned}$$

with $\text{Taylor}^1 \neq \text{Taylor}^2$. Together with the other structural parameters and the equations describing the behaviour of the private sector, Taylor^1 and Taylor^2 imply two different economic structures, with two different reduced-form VAR representations, and therefore, as a logical corollary, two different structural VAR representations, that is:

$$\begin{aligned} \text{Taylor}^1 &\Longrightarrow \text{DSGE}^1 \Longrightarrow \text{VAR}^1 \Longrightarrow \text{SVAR}^1 \Longrightarrow \text{MonetaryRule}^1 \\ \text{Taylor}^2 &\Longrightarrow \text{DSGE}^2 \Longrightarrow \text{VAR}^2 \Longrightarrow \text{SVAR}^2 \Longrightarrow \text{MonetaryRule}^2 \end{aligned}$$

where MonetaryRule^1 and MonetaryRule^2 are the interest rate equations in the two SVAR representations, SVAR^1 and SVAR^2. The key issue is that, in general, switching MonetaryRule^1 and MonetaryRule^2 is not the same as switching Taylor^1 and Taylor^2 in terms of their impact on (properties of) the economy. On the contrary, as

[100] Giannone and andLucrezia Reichlin (2009) provide a completely different critique of the traditional interpretation of a fall in the innovation variance of VAR residuals. Specifically, they show that, when larger and larger information sets are considered, the role of such volatility decreases in explaining the Great Moderation becomes smaller and smaller, whereas the role of changes in the economic structure becomes more and more prominent.

[101] What follows is based on Benati (2009a).

Benati (2009a) shows, the difference is sometimes substantial. Based on DSGE models, in particular, Benati (2009a) investigates under which conditions the SVAR-based policy counterfactual is capable of correctly capturing the impact of the authentic counterfactual on the (reduced-form) properties of the economy. He shows that the SVAR-based counterfactual performs well only under extreme circumstances, that is

- if the DSGE model is completely backward-looking,[102] or
- if the model is purely forward-looking, all the structural shocks are white noise, and both the 'benchmark' and the alternative Taylor rules are such as to guarantee determinacy (that is, uniqueness of the solution), so that the model's solution is vector white noise.

Except for these extreme cases, in *all* other circumstances (e.g., when the model is partly backward- and partly forward-looking, and/or the shocks are not white noise) switching MonetaryRule^1 and MonetaryRule^2 fails to replicate the impact of switching Taylor^1 and Taylor^2—sometimes substantially so—thus pointing toward a key *conceptual* weakness of policy counterfactuals based on structural VARs.

Figure 4.6 provides an illustration of this issue, by showing results from the following experiment. Consider the standard backward- and forward-looking New Keynesian model described by

$$R_t = \rho R_{t-1} + (1-\rho)[\phi_\pi \pi_t + \phi_y y_t] + \epsilon_{R,t} \tag{13}$$

$$y_t = \gamma y_{t+1|t} + (1-\gamma) y_{t-1} - \sigma^{-1}(R_t - \pi_{t+1|t}) + u_t \tag{14}$$

$$\pi_t = \frac{\beta}{1+\alpha\beta}\pi_{t+1|t} + \frac{\alpha}{1+\alpha\beta}\pi_{t-1} + \kappa y_t + v_t \tag{15}$$

where R_t, π_t and y_t are the nominal rate, inflation and the output gap, and the rest of the notation is obvious. We calibrate the model based on Benati (2008b)'s modal estimates for the post-WWII United States as reported in his Table XII. We then compute its theoretical VAR and SVAR representations conditional on these 'benchmark' estimates, which we call VAR^B and SVAR^B respectively. The two representations imply certain benchmark values for the series' theoretical standard deviations, which we collect in a vector labeled as STDs^B. In line with the previous notation, we label the benchmark Taylor rule, and the benchmark interest rate equation in SVAR^B as Taylor^B and MonetaryRule^B, respectively. We then consider grids of values for ρ, from 0.4 to 0.95, and for ϕ_π, from 0.25 to 2.5. (On the other hand, we keep the other parameter(s) in the Taylor rule at the value(s) implied by the benchmark estimates we consider.) For each combination of values of ρ and ϕ_π in the grids, we solve the DSGE model,[103] and we compute its theoretical VAR and SVAR

[102] Quite obviously, in this case the DSGE model is already a structural VAR.

[103] Given the wide ranges of values we consider for ρ and ϕ_π, some of their combinations imply indeterminacy of the model solution. In these cases, we solve the model as in Lubik and Schorfheide (2004), picking the solution that they label as 'continuity'.

representations, which we call VAR^A and SVAR^A respectively—where A stands for 'alternative'—and the associated vector of implied theoretical standard deviations, STDs^A. Again, we label the alternative Taylor rule and the interest rate equation in SVAR^A as Taylor^A and MonetaryRule^A, respectively. By definition, switching Taylor^B and Taylor^A within the DSGE model (that is: performing the authentic counterfactual) inverts the two vectors STDs^B and STDs^A. If the SVAR-based counterfactual worked fine we should be able to obtain *exactly* the same result by switching MonetaryRule^B and MonetaryRule^A. As we will now show, this is not the case. Let SVAR^C—where C stands for 'counterfactual'—the SVAR we obtain by imposing MonetaryRule^B withing SVAR^A (that is, we take away MonetaryRule^A and we replace it with MonetaryRule^B), and let VAR^C be its associated reduced-form VAR. VAR^C implies a vector of theoretical standard deviations for the series of interest, which we label as STDs^C. If the SVAR-based counterfactual worked fine, for each possible combination of alternative values of ρ and ϕ_π in the grids, we would have STDs^C=STDs^B, so that for each individual variable i it would uniformly be STDs$_i^C$/STDs$_i^B$=1. On the other hand, the extent to which the SVAR-based counterfactual fails to replicate the impact of the authentic counterfactual is captured, for each series, by how much such ratio deviates from one. As Figure 4.6 show, the SVAR-based counterfactual clearly fails to replicate the outcome of the authentic counterfactual, as for either series the ratio STDs$_i^C$/STDs$_i^B$ is, in general, different from one—sometimes quite markedly so—and it is very close to one only for combinations of ρ and ϕ_π which are sufficiently close to the benchmark estimates. It is also worth stressing that the magnitude of the error made by the SVAR-based counterfactual is in general non-negligible, and is often quite substantial.

4.1.2 Results based on DSGE models

Given the problems associated with the *interpretation* of the evidence produced by the structural VAR literature, the natural reation is to turn to DSGE models. Although in this Section we will discuss the results produced by this literature, a key *caveat* to be kept firmly in mind is that, as a matter of logic, the reliability of all these results crucially hinges upon the extent to which the model which is being used correctly captures the key features of the underlying structural data generation process. We will start with a review of the literature, and we will proceed with a simple illustration based on an estimated DSGE model.

A review of the literature The key idea behind Clarida, Gali, and Gertler (2000)'s highly influential interpretation of the transition from the Great Inflation to the Great Moderation is that, before October 1979, U.S. monetary policy had been so weakly counter-inflationary as to allow the economy to move inside what is technically called the 'indeterminacy region'. A crucial feature of such a peculiar 'state of the economy' is that—since expectations are no longer firmly pinned down

by policy—macroeconomic fluctuations no longer uniquely depend on fundamental shocks, and, in line with Goodfriend (1993)'s analysis of 'inflation scares', may instead be influenced by non-fundamental elements Further, a second key feature of the indeterminacy regime, compared with the determinacy one, is that even in the absence of autonomous fluctuations in expectations the economy is characterised by greater persistence and volatility across the board.

How do these fluctuations look like? Figure 4.7 provides a simple illustration of the kind of macroeconomic dynamics induced by Benati and Surico's extreme version of Clarida *et al.*'s hypothesis. The figure shows results from a single stochastic simulation from their estimated DGP, and clearly shows that Clarida *et al.*'s hypothesis is capable, in principle, to generate 'Great Inflations' and subsequent 'Great Moderations' uniquely as a result of changes in policy, and without any change in the volatilities of the structural disturbances. A key limitation of Clarida *et al.*'s original contribution was that they only estimated the model's monetary policy reaction rule, whereas all remaining structural parameters were calibrated. Subsequent contributions went beyond this limitation. Lubik and Schorfheide (2004), in particular, replicated the same finding of indeterminacy before October 1979 and determinacy after that, although their estimated model was not capable of generating volatility declines for all series *uniquely* as a result of a change in policy. The same result was obtained, based on a more sophisticated model, by Boivin and Giannoni (2006), who summarised their findings as follows.

> 'The story that emerges is thus not an all-shocks or an all-policy one, but a more subtle one. In order to explain the decline in inflation and output volatility, it is crucial for the policy rule to have changed the way it has, along with the shocks.'

Not all DSGE-based analyses, however, point towards an important role for policy. Based on an estimated large-scale model of the U.S. economy, Smets and Wouters (2007) conclude that

> '[...] the most important drivers behind the reduction in volatility are the shocks, which appear to have been more benign in the last period.'

It is to be noticed, however, that, in estimation, Smets and Wouters restricted the parameter space to the determinacy region, so that, strictly speaking, their results are not directly comparable to those discussed so far. Finally, Justiniano and Primiceri (2008) (henceforth, JS) introduce time-variation in the volatilities of the DSGE model's structural disturbances, identifying a reduction in the variance of 'investment shocks' as the key driving force behind the U.S. Great Moderation, with a limited role, instead, for changes in the conduct of monetary policy (it is to be noticed, however, that when they allow for the possibility of indeterminacy in the pre-Volcker period they do identify, indeed, evidence of a passive policy). Although their model

is not sufficiently detailed to allow for a proper explanation of what the identified 'investment shocks' truly mean, JS propose an intriguing interpretation based on the decrease in financial frictions around the first half of the 1980s associated with the expanded access to credit and borrowing for both firms and households. An important point to stress is that, under this interpretation, the reduction in the volatility of what JS's model identifies as 'investment shocks' should not be regarded as 'luck' according to the traditional meaning this word takes in the English language. The financial liberalisation which started in the United States in the first half of the 1980s was indeed not the result of 'luck' in any meaningful sense, but it rather was the result of specific policy decisions.

Summing up, results based on DSGE models do not offer a clear-cut answer to the question: 'What are the causes of the Great Moderation?'. Overall, however, two messages emerge from the current state-of-the-art of DSGE models-based analysis. *First*, in line with both the narrative evidence of (e.g.) DeLong (1997) and Romer and Romer (2002) for the United States, and the belief—widespread within the central banking community—that monetary policy-making has significantly improved since the times of the Great Inflation, DSGE-based analyses often identify important changes in the conduct of monetary policy, which appears to have become more responsive to inflation. *Second*, different from VAR-based analyses, no DSGE-based study supports sheer 'good luck' as the key explanation for the Great Moderation, as explanations range from a combination of luck and improved policy, with an important role for the latter (as in the work of Boivin and Giannoni), to less volatile measured 'investment shocks' which however might well simply capture the financial liberalisation of the beginning of the 1980s.

Results based on an estimated DSGE model with non-zero trend inflation
The model we use in this sub-section is the one proposed by Ascari and Ropele (2007), which generalises the standard New Keynesian model analysed by Clarida, Gali, and Gertler (2000) and Woodford (2003) to the case of non-zero trend inflation, nesting it as a particular case.

The Phillips curve block of the model is given by

$$\Delta_t = \psi \Delta_{t+1|t} + \eta \phi_{t+1|t} + \kappa \frac{\sigma_N}{1+\sigma_N} s_t + \kappa y_t + \epsilon_{\pi,t} \tag{16}$$

$$\phi_t = \chi \phi_{t+1|t} + \chi(\theta\text{-}1)\Delta_{t+1|t} \tag{17}$$

$$s_t = \xi \Delta_t + \alpha \bar{\pi}^{\theta(1-\epsilon)} s_{t-1} \tag{18}$$

where $\Delta_t \equiv \pi_t - \tau\epsilon\pi_{t-1}$; π_t, y_t, and s_t are the log-deviations of inflation, the output gap, and the dispersion of relative prices, respectively, from the non-stochastic steady-state; $\theta>1$ is the elasticity parameter in the aggregator function turning intermediate inputs into the final good; α is the Calvo parameter; $\epsilon \in[0,1]$ is the degree of indexation; $\tau \in[0,1]$ parameterises the extent to which indexation is to

past inflation as opposed to trend inflation (with τ=1 indexation is to past inflation, whereas with τ=0 indexation is to trend inflation); Δ_t and ϕ_t are auxiliary variables; σ_N is the inverse of the elasticity of intertemporal substitution of labor, which, following Ascari and Ropele (2007), we calibrate to 1; and $\psi \equiv \beta\bar{\pi}^{1-\epsilon}+\eta(\theta\text{-}1)$, $\chi \equiv \alpha\beta\bar{\pi}^{(\theta\text{-}1)(1\text{-}\epsilon)}$, $\xi \equiv (\bar{\pi}^{1-\epsilon}\text{-}1)\theta\alpha\bar{\pi}^{(\theta\text{-}1)(1\text{-}\epsilon)}[1\text{-}\alpha\bar{\pi}^{(\theta\text{-}1)(1\text{-}\epsilon)}]^{-1}$, $\eta \equiv \beta(\bar{\pi}^{1-\epsilon}\text{-}1)[1\text{-}\alpha\bar{\pi}^{(\theta\text{-}1)(1\text{-}\epsilon)}]$, and $\kappa \equiv (1+\sigma_N)[\alpha\bar{\pi}^{(\theta\text{-}1)(1\text{-}\epsilon)}]^{-1}[1\text{-}\alpha\beta\bar{\pi}^{\theta(1\text{-}\epsilon)}][1\text{-}\alpha\bar{\pi}^{(\theta\text{-}1)(1\text{-}\epsilon)}]$, where $\bar{\pi}$ is gross trend inflation measured on a quarter-on-quarter basis.[104] In what follows we uniquely consider the case of indexation to *past* inflation, and we therefore set τ=1. We close the model with the intertemporal IS curve

$$y_t = \gamma y_{t+1|t} + (1-\gamma)y_{t-1} - \sigma^{-1}(R_t - \pi_{t+1|t}) + \epsilon_{y,t} \tag{19}$$

and the monetary policy rule

$$R_t = \rho R_{t-1} + (1-\rho)[\phi_\pi \pi_t + \phi_y y_t] + \epsilon_{R,t} \tag{20}$$

and we estimate it *via* the Bayesian methods described in Appendix D.

Table 1 reports the priors for the model's structural parameters. Following, e.g., Lubik and Schorfheide (2004) and An and Schorfheide (2007), all parameters are assumed, for the sake of simplicity, to be *a priori* independent from one another. The table reports the parameters' prior densities, together with two key objects characterising them, the mode and the standard deviation.

Handling the possibility of indeterminacy in estimation An important issue in estimation concerns how to handle the possibility of indeterminacy. In a string of papers,[105] Guido Ascari has indeed shown that, when standard New Keynesian models are log-linearised around a non-zero steady-state inflation rate, the size of the determinacy region is, for a given parameterisation, 'shrinking' (i.e., decreasing) in the level of trend inflation.[106] Ascari and Ropele (2007) in particular show that, conditional on their calibration, it is very difficult to obtain a determinate equilibrium for values of trend inflation beyond 4 to 6 per cent. Given that, for all of the countries in our sample, inflation has been beyond this threshold for a significant portion of the sample period (first and foremost, during the Great Inflation episode), the imposition of determinacy in estimation over the entire sample, which is what is routinely done in the literature is very hard to justify. In what follows we therefore estimate the model given by (16)-(20) by allowing for the possibility of *one-dimensional* indeterminacy,[107]

[104] To be clear, this implies that (e.g.) a steady-state inflation rate of 4 per cent per year maps into a value of $\bar{\pi}$ equal to $1.04^{1/4}$=1.00985.

[105] See in particular Ascari (2004) and Ascari and Ropele (2007).

[106] On this, see also Kiley (2007).

[107] This is in line with Justiniano and Primiceri (2008). As they stress (see Section 8.2.1), '[t]his means that we effectively truncate our prior at the boundary of a multi-dimensional indeterminacy region'.

and further imposing the constraint that, when trend inflation is lower than 3 per cent, the economy is within the determinacy region.[108]

Was the economy under indeterminacy during the 1970s? Conceptually in line with Lubik and Schorfheide (2004), the priors reported in Table 1 are calibrated in such a way that the prior probability of determinacy for *zero* trend inflation is equal to 50 per cent (see the first column of Table 2). The second column illustrates Ascari's point: *ceteris paribus*, an increase in trend inflation causes the determinacy region to 'shrink', so that, within the present context, the prior probability of determinacy conditional on the actual values taken by trend inflation during the 1970s is strictly lower than 50 per cent. In particular, for the United Kingdom—which, among all the countries considered herein, had the highest average inflation during the decade—the prior probability of determinacy falls to 37 per cent.

The last column of Table 2 reports the fraction of draws from the posterior distribution generated *via* Random Walk Metropolis for which the economy was under determinacy: for all countries it is well below 50 per cent, and in most cases it is very close to zero. In particular, in two instances—one of them, unsurprisingly, the United Kingdom—it is actually equal to zero.

The implication of all this is that the debate over the issue of whether, during the 1970s, the economy was under indeterminacy—which up until now has been conducted based on estimated New Keynesian models log-linearised around *zero* trend inflation—acquires a completely different perspective once one takes seriously the empirical implications of Ascari's point. The implication of all this is that it appears as very unlikely that, during the Great Inflation episode, the economy may have been under determinacy. The key reason for this is *not* the standard one suggested by Clarida *et al.* (2000)—that is, monetary policy was not sufficiently reactive to (expected) inflation—but rather the fact that average inflation was comparatively high during that decade.

Explaining the Great Moderation: shocks, monetary policy, or changes in trend inflation? Figure 4.8 shows the posterior distributions of the Taylor rule coefficients for the six countries in our samples, for both the 1970s and the most recent regimes/periods. For all countries, with the exception of Japan, there has been a clear increase in the coefficient on inflation, whereas for all countries except

[108] The constraint that, below 3 per cent trend inflation, the economy is under determinacy was imposed in order to rule out a few highly implausible estimates we obtained when no such constraint was imposed. In particular, without imposing any constraint, in a few cases estimates would point towards the economy being under indeterminacy even within the current low-inflation environment, which we find *a priori* hard to believe. These results originate from the fact that, as stressed e.g. by Lubik and Schorfheide (2004), (in)determinacy is a *system* property, crucially depending on the interaction between *all* of the (policy or non-policy) structural parameters, so that parameters' configurations which, within the comparatively simple New Keynesian model used herein, produce the best fit to the data may produce such undesirable 'side effects'.

the Euro area there has been an increase in the coefficient on the output gap. Finally, for three countries (the U.S., the U.K., and Australia) there has been an increase in the coefficient on the lagged interest rate. Overall, empirical evidence therefore clearly supports the conventional wisdom notion of an 'improvement' in the conduct of monetary policy during the most recent period.

At the same time, as Figure 4.9 clear shows, for all countres except the Euro area there has been a clear decrease in the volatilities of structural innovations, so that the most recent period has not only been characterised by better monetary policy, but also by 'luck'.

[**To be finished: decompose the changes in the series' standard deviations into the components attributable to changes in the innovation variance of the structural shocks, changes in monetary policy, and changes in trend inflation (as shown by Ascari, trend inflation has an impact on the volatility of macroeconomic series, so that, in principle, part of the volatility decreases associated with the Great Moderation might be explained by decreases in trend inflation).**]

4.1.3 Structural change

Although the literature on the Great Moderation has focussed, to an almost exclusive extent, on the dichotomy 'good policy versus good luck', a few papers have explored the possibility that changes in the structure of the economy unrelated to changes in the conduct of monetary policy might have played a key role. At first sight, one obvious possibility might appear the well-known, secular shift in the structure of advanced economies away from comparatively more volatile agriculture and manufacturing, and towards comparatively more stable services. As Figure 4.10 makes clear, however, with the only exception of the years around WWII—which saw a sudden, temporary increase in the share of the government sector, and corresponding decreases in the shares of all other sectors (except agriculture, forestry, fisheries, and mining)—such secular shifts have been remarkably gradual, so that, as a simple matter of logic, they cannot explain the rapid volatility decreases documented, e.g., in Figure 4.1.

A 'structural change' explanation originally advanced, for the United States, by McConnell and Perez-Quiros (2000) was based on the notion of significant improvements in inventory management around the first half of the 1980s, but it was subsequently criticised on both theoretical and empirical grounds. A subtler 'structural change' explanation is the one suggested by Gali and Gambetti (2009), who identify changes in the pattern of co-movement among series in the post-WWII United States, stressing that, whereas this is incompatible with the pure 'good luck' explanation, it is instead compatible with the notion of structural change.

4.1.4 Taking stock: where do we stand on the causes of the Great Moderation?

Research on the Great Moderation proceeds at a very intense pace, so that any statement on the relative importance of luck, policy, and structural change must necessarily be regarded as tentative. With this *caveat* in mind, it is possible to extract, from the previous discussion, several provisional conclusions. *First*, for strictly conceptual reasons the results produced by the structural VAR literature—which uniformly point towards 'good luck'—are difficult to interpret, in the sense that, when seen from a general equilibrium (i.e., DSGE) perspective, results similar to those produced by VAR studies can be equally plausibly generated conditional on the 'good luck' and 'good policy' scenarios. *Second*, results based on estimated DSGE models point towards a combination of both smaller shocks and improved monetary policy. *Third*, structural change explanations appear, for the time being, significantly less plausible.

4.2 Japan

The experience of the Japanese economy during this period could not have been more different from that in America and Europe. Rather than battling with inflation and experiencing healthy and stable real GDP growth, the BoJ found itself operating within a deflationary environment beset by several bouts of negative real GDP growth (see Figure 4.11).

Why did the Japanese economy experience a 'lost decade' and not a 'nice decade', and to what extent did monetary policy help or hinder the path out of deflation?

There are four main theories. We will deal with the easiest to dismiss first, before assessing the final three.

4.2.1 Structural and cultural rigidities

Some contemporary commentators, particularly in the West, have suggested that Japan's problems stemmed from structural problems, similar to those painfully eliminated in the U.S. and U.K. in the 1980s. In particular, Alan Greenspan (2003) argued that bankruptcy laws and conservatism at Japanese banks led to an inability to weed out zombie companies that were the root cause of Japan's problems. Others have argued that the economy was constrained by the inherent conservatism of a society that held consensus in the highest regard. Policy makers were therefore too slow to act and too timid when they did.

But the argument that the Japanese economy mainly suffered from structural problems does not stand up to inspection. The country had a large current account surplus and good products, and was renowned for having very few strikes. The economy had to battle through deflation, not high inflation. Interest rates were low, not high. Unemployment was also consistently low throughout the period. What's more, as Bernanke (1999) noted

> '[...] if Japan's slow growth (in the 1990s) were due entirely to structural problems on the supply side, inflation rather than deflation would probably be in evidence.'

Moreover, fiscal policy was loosened considerably, to the detriment of the public finances, hardly evidence of inherent conservatism in policy making circles.

4.2.2 The role of monetary policy

The Bank of Japan has been criticised on three levels:

- A failure to tighten monetary policy during 1987-89 when inflation was gathering momentum, leading to a bubble in asset prices.
- The apparent aim by the BoJ to 'prick' the stock market bubble between 1989 and 1991 by directing the uncollaterised overnight call rate up from 4.5% in March 1989 to a peak of 8.5% in March 1991, which induced the asset price crash.
- The failure to loosen monetary policy fast enough in the subsequent period, and the hesitancy in using unconventional measures to loosen monetary policy further when the nominal zero interest rate bound had been reached.

In particular, it is this latter claim that deserves most attention. In summary, it is argued that there were five policies that the BoJ could have pursued to make monetary policy more effective when the nominal interest rate bound had been hit:

1) *Depreciate the Yen* The 1990s saw a strong appreciation of the Yen, as demand for Japanese goods abroad remained strong. In particular, even as the economy dipped back into recession in 1999, the yen strengthened from 145.0 Yen/dollar in August 1998 to 100.2 yen/dollar in December 1999. This led to import prices falling considerably, putting further downward price pressure on domestically-produced goods. Meltzer (1999), McCallum (1999) and Svensson (2001) argued that the BoJ should have depreciated the value of the currency through large open-market sales of yen, and McKinnon (1999) that there should have been an agreement between Japan and the USA to stabilize the yen at a lower level.

2) *Money-financed transfers to households* Monetary policy could have been loosened further with a Friedman-style 'helicopter drop' (Friedman, 1969; Bernanke, 1999) of newly-printed money. This could have been achieved via a one-off tax reduction, financed by printing money.

3) *Non-Standard open-market operations* Another option that the BoJ did not pursue until 2001 was the unsterilised purchase of assets by the central bank. The aim of such a policy would be to raise the prices of particular assets in order to stimulate spending and lending (e.g. Auerbach and Obstfeld, 2005). But a problem with such

a policy is that it 'privatises profits but socialises losses' for investors, encouraging then to take what is seen as a one-way bet, the 'Greenspan put'.

4) *The BoJ should either have set a price level target, or commit to future positive inflation* The intention was to influence expectations and hence nominal interest rates, (Eggertson and Woodford, 2003; Woodford, 2003). The problem was that this would not have been credible, without appropriate instruments to achieve it.

5) *Improve the transparency of monetary policy* Krugman (1999) has argued that monetary policy in Japan was too uncertain, and left both markets and consumers guessing. Instead, the authorities should have set a (relatively high) inflation target in order to anchor expectations and quantify the objectives.

The BoJ has vigorously defended its actions in the 1990s. First, they argued that they had eased monetary policy on a scale never seen before. In the words of Okina (1999), the bank had engaged in 'historically unprecedented accommodative monetary policy.' With regard to its Yen policy, the BoJ argued that it did not have the legal authority to set the yen exchange rate (this was under the auspices of the Ministry of Finance), and that a large scale depreciation would have created worldwide instability and international tensions. The BoJ also defended its record of transparency by arguing that setting a target that it did not know how to achieve would endanger its credibility (however, as Bernanke (op. cit.) states

> 'I do not see how credibility can be harmed by straightforward and honest dialogue of policymakers with the public.'

Officials at the bank also argued that a rapid loosening of monetary policy could cause financial instability, potentially detrimental to the wider economy, and could run counter to the BoJ's responsibility for financial stability (see Okina (1993)). In addition, specifically regarding quantitative easing, Ueda (2001a) argued that, with zero interest rates, an injection of any quantity of money would not affect the economy, as it would merely increase banks' idle excess reserves.

This 'inertia' view ran contrary to the traditional monetarist view that monetary policy was determined exogenously by the central bank, and was capable of increasing nominal output by stimulating the growth of monetary aggregates. But, when M1 and M2+CDs growth increased quite sharply in 1992, without a corresponding pick-up in economic growth (due to a decline in the velocity of money), this argument appeared dented.

The BoJ did eventually turn to other measures when it became clear that all conventional measures had been exhausted and were having little, or no, success in ending deflation. Between 1999 and 2001, the BoJ pursued a Zero Interest Rate Policy (ZIRP), under which the uncollaterised overnight call rate fell to 0.02-0.03%. But such accommodative monetary policy was not sufficient to bring about economic growth or positive inflation (real output fell by 1.0% in 2001, and core CPI (CPI excluding fresh food and energy) at –0.9%, was negative for the 3rd consecutive year).

Since the policy rate had reached its nominal interest rate floor, the BoJ was, therefore, forced to affect the money supply via unconventional and unprecedented means. The BoJ's Quantitative Easing policy (QE) was the result, and was implemented for five years between March 2001 and March 2006. Ugai (2006) summarises the aims of QE by referring to its 'three pillars':

- to change the main operating target of money market operations from the uncollaterised overnight call rate to the outstanding level of current account balances (CABs) held by financial institutions at the BoJ; and to provide sufficient liquidity to realize a CAB substantially in excess of the required reserve levels.

- To commit that ample liquidity provision would remain in place until CPI (excluding perishables) recorded growth of zero, or above, year on year. Unlike the commitment under the ZIRP, which stated, somewhat ambiguously, to 'continue the ZIRP until deflationary concern is dispelled', QE's commitment was directly linked to the actual numerical track record of the CPI. Ueda (2005) argues that the target was more transparent and more effective in lowering short to mid term market interest rates.

- To increase the amount of outright purchases of long-term Japanese government bonds, up to a ceiling of the outstanding balance of bank notes issued, should the BoJ consider such an increase to be necessary for providing liquidity smoothly.

The target for CABs at the BoJ was initially set at ¥5tn in March 2001, higher than the required reserve level of ¥4tn. This target was then progressively raised to a range of ¥30tn to ¥35tn in January 2004, where it stayed until the end of the QE. This excess liquidity had the effect of reducing the overnight call rate to 0.0001%.

In order to meet the targeted level of CABs, the BoJ initially purchased ¥400bn worth of long-term government bonds per month. This was stepped up to ¥1,200bn per month by the beginning of October 2002. From July 2003 to March 2006, the BoJ also purchased asset-backed securities, in an attempt to support the development of markets for such securities, and to strengthen the transmission mechanism of monetary policy.

How successful was the QE? According to the aims laid down in the three pillars, QE achieved it aims. Core CPI turned positive from November 2005, and rose to 0.5% in January 2006. So, on 9th March 2006, the BoJ announced that it expected the annual rate of core CPI to remain positive. As a result, it judged that its commitment under QE had been met, and proceeded to change the operating target of monetary policy back to the uncollaterised overnight call rate, which it continued to target at a zero effective rate.

But what of the wider effects of QE? First, note that the policy did not contain an explicit commitment to raise the nominal level of aggregate demand, raise real activity, or to decrease uncertainty in the financial system.

Nevertheless, the policy had wider effects. For a start, QE—independent of the ZIRP—was successful at reducing uncertainty over policy rates in financial markets, lowering government bond yields and raising inflation expectations. Indeed, as Ugai (2006), p. 15, summarises

> 'every empirical analysis detects the effect whereby the QE's commitment linked to actual core CPI performance lowered the yield curve, centring on the short- to medium-term. And this effect was stronger than under the ZIRP commitment linked to future analysis of dispelling deflationary concerns.'

There are several key papers in this area. Baba *et al.* (2005) assess the effectiveness of QE on 3, 5 and 10 year bond yields by simulating a counterfactual yield curve using a modified Taylor rule with a zero bound interest rate constraint. Their results show that the commitment had the effect of lowering the yield on 3-year and 5-year bonds by 0.4-0.5% and by 0.2% on 10-year bonds from 2003. Okina and Shiratsuka (2004) show that expectations for the duration of zero interest rates lengthened from about six months during the ZIRP period to more than one year over the course of QE, which in turn helped to lower money market interest rates and therefore the funding costs of banks. Marumo *et al.* (2003) and Bernanke *et al.* (2004) also produce evidence to suggest that the QE's commitment to low short term interest rates for a period of some time in the future affected expectations for interest rates with longer terms and reduced the yields of other financial assets in financial markets.

Secondly, QE was successful in raising the prices of other assets via a portfolio rebalancing effect. Kimura and Small (2006) estimate that each additional ¥10tn increase of long term government bond purchases lowered Aa grade corporate bonds by 6-8 basis points.

Finally, the QE (and the ZIRP prior to this) had a positive effect in dispelling the funding concerns of financial institutions. This was reflected in the spreads of 3 month TIBOR minus 3 month LIBOR falling virtually to zero upon the commencement of the QE in 2001. This compared very favourably to the period between November 1997 and January 1999 where the spread of three month TIBOR minus 3 month LIBOR rose on several occasions to over 300 basis points.

However, any causal link between QE, independent of the ZIRP, and coincident effects on prices and the real economy is subject to doubt in much of the empirical literature. Kimura *et al.* (2003), for example, believe that the increase in the monetary base attributable directly to QE in 2002 had no effect on core CPI or on the output gap. Similarly, Fujiwara (2006) finds no significant relationship between the increase in the monetary base attributable to QE and either CPI or industrial production.

The main reason for this was that the historical relationships between base money, broad money and nominal GDP broke down and behaved unpredictably. The ratio of M4 to M0 (the "broad money multiplier") fell from 28.5 to a low of 18.9, as the large increase in M0 were not reflected in M4 balances due to problems with bank lending (see below). The velocity of money (the ratio of nominal GDP to base money (M0))

also fell sharply, halving from 14.6 in 1992 to a 7.0 in 2008, (Figure 4.11). The effects of QE on aggregate nominal demand were therefore blunted. In short

> '[...] the erosion of the financial intermediary functions of banks burdened by nonperforming loans and corporate balance sheet adjustment [...] diminished the manifestation of policy effects' (Ugai, 2006).

QE also failed to stimulate bank lending. In the five years between March 2001 and March 2006, bank lending to the private sector fell by about 3% a year—a cumulative drop of 16% (more on this later), though some of this fall was offset by an increase in lending to the public sector, (Figure 4.11). Furthermore, the scale of QE was much smaller, and far more gradual, than recently in the U.S. and U.K.. At 2.5% of M3, the injection of funds was relatively small. Over a period of five years, this was quite a timid approach.

But perhaps there are two defences against these criticisms. First, QE was unprecedented – there were no former examples to follow. Secondly, as Congdon (2009), p. 3, rightly points out, "we do not know what would have happened if the bank of Japan had not pursued QE." Assessing its effects requires the construction of an uncertain counterfactual.

4.2.3 Reluctance of the banks to lend

Proponents of this view argue that banks in this period, being risk-adverse, overleveraged and with too many non-performing loans (NPLs), were reluctant (or unable) to expand their loan books. So they restricted the supply of funds, inhibiting economic growth, in order to minimise losses and improve their credit ratings—which were terrible (none of the domestic Japanese banks had a financial rating from Moody's higher than "D" until May 2007, whereas "B-" is generally regarded to be the lowest acceptable rating for a bank).

To make matters worse, the fear of insolvency led to depositors withdrawing their savings from domestic banks and depositing them off-shore, or investing them in safe-haven assets such as gold. This deprived the banks of new funds to lend. What new capital they received generally went towards the cost of asset and loan write-downs.

What's more—and somewhat surprisingly—a high proportion of the new loans were given to existing, technically-insolvent companies. banks were essentially betting that assets (particularly land) prices, having fallen so low from their peak, would rise in the future. So banks thought it worth waiting, either for the borrower to return to solvency in time, or to wait for the value of the collateral to rise. Such a preference may well have reduced the dynamism of the Japanese economy.

Certainly bank lending did contract sharply for a prolonged period. Net new lending peaked at ¥31.1tn in 1989. But this had turned negative by 1999, and remained so until 2005. The outstanding stock of loans fell by 5% alone in 2003.

But, such an explanation is somewhat simplistic. If the supply of credit was the only problem, then one would have expected three things to happen:

- if the demand for funds from corporates was strong, then one would have expected to see the corporate bond market expanding. But the growth rate of corporate bonds outstanding fell gradually, turning negative in 2002 as corporates reduced their outstanding debts.

- If major Japanese banks with high proportions of NPLs had been the problem, then one might have expected to see a significant expansion of foreign banks in the Japanese economy (who did not have NPLs on the same scale), especially after the "Big Bang" financial reforms in Japan that made it possible for foreign banks to open branches wherever they saw fit. But the market share of foreign banks fell for much of the post-boom period.

- If SMEs who had to rely on loans from banks for funding wanted to borrow, then borrowers would have competed for the limited supply of loans by offering to pay higher interest rates. But the average lending rate of Japanese banks fell continuously from c.8% in 1991 to c.1.5% in 2005, and the spread fell a little from 154 basis points in 1993 to 139 by end 2005.

4.2.4 'Balance sheet recession' / Demand for credit problem

These criticisms of the 'supply of credit' argument therefore potentially lead to another explanation: that it was the decline in demand for credit from the private sector that was the cause of deflation.

This narrative focuses on the collapse of asset prices on household and corporate balance sheets. Massive falls in asset prices left profitable firms technically insolvent as the value of their liabilities became significantly in excess of the value of their assets. The TOPIX share index fell by 65% from its peak in 1989 to its low in 2003. Commercial land prices in the six major cities fell by 87% between their peak in 1990 and their trough in 2004. Golf course membership fell 95% from their peak in 1989 to their trough in 2003. Falling land and stock prices destroyed ¥1,500tn in the nation's wealth (equivalent to £9.5tn or $15.2tn in today's currency)—a figure equal to the entire nation's stock of personal financial assets (Figure 4.11).

During a normal recession when demand falls, weaker firms go bankrupt. However, Japanese firms generally remained profitable, with positive net cash flows, despite the domestic recession, partly due to a strong demand for Japanese goods from international markets. Instead, firms were profitable but had negative net asset positions. Firms therefore switched their focus from profit maximising and started debt minimising, even though interest rates were at record lows. What they needed was time to generate the cash that would eventually return them to solvency.

According to this view, the absence of willing borrowers in Japan threw the economy into a contraction. Firms and households paid down their debt, but there was no demand for loans. The lack of demand for loans further depressed asset prices,

causing the net worth of households and firms to fall further, causing them to demand fewer loans and redouble their efforts to pay down their debts to return to solvency.

By far the largest structural transformation in the Japanese economy was the transition of the corporate sector from being net investors (the usual and natural position of the corporate sector as wealth creators) to becoming net savers. Koo (2008) calculates that this shift in corporate behaviour led to a drop in demand equivalent to some 22% of GDP. The corporate sector went from running a financial deficit equivalent to 12% of GDP in 1990 (making the sector a net investor) to running a surplus equivalent to 10% of GDP in 2003.

Despite this massive shock to aggregate demand from falling wealth and net corporate saving, GDP always stayed above its bubble peak in both real and nominal terms. The economy was able to do this, for three reasons. First, households drew down their savings considerably in order support expenditure, at a time when bonuses were slashed, jobs lost and earnings growth sharply reduced. Previously, Japanese households were renowned for having the highest savings rates in the world. But, according to the central Council for Financial Services Information (2006), by 2006 one in four Japanese households had no savings at all. Gross national savings as a percentage of GDP fell from a peak of 34.7% in 1992 to a trough of 25.9% in 2002. In aggregate, households went from running a financial surplus equivalent to 10% of GDP in 1990 to only 1% or so in 2003. Secondly, the Government stimulated the economy by running a massive fiscal surplus, equivalent at its peak to close to 11% of GDP in 1998. Public sector debt gradually spiralled upwards from 68.8% of GDP in 1991 to 196.3% of GDP in 2008, unprecedented levels for a G7 country in peace-time. Third, when the crisis in the banking sector reached a head in 1997, the Government's blanket deposit guarantee prevented a major run on Japan's banks that would have most likely led to a severe recession.

4.2.5 Conclusion

Probably the main factor responsible for Japan's protracted recession was the spiral of debt deflation, which was not offset by sufficiently quick or aggressive policy measures, i.e. a mixture of hypotheses 2 and 4 above. The debt deflation deterred bank borrowing, and so a policy of QE aimed primarily at commercial bank reserves had little traction on the wider monetary aggregates.

4.3 Banking in post-communist countries

The foremost political event during these decades was the collapse of communism, especially as an economic system. Even in most of those, mostly Asian, countries where the communist party remained in political command, the economy was transformed into a market system with competition, fairly flexible prices, pursuit of profit maximisation, and some attempt to allocate capital into its most profitable use, e.g. in China and Vietnam, but not in North Korea.

The communist system had had no use for commercial banks, nor for a capital market. Capital was allocated by the Plan, and savings centralised via the profits of State Owned Enterprises (SOEs). Persons had limited, rudimentary savings outlets, i.e. cash or a state-run savings bank. The single central bank was not so much a bank, but rather a central accounting mechanism keeping tabs on the progress of the longer-term Plan by watching whether the on-going cash flows were consistent with it.

So when communism began to crumble, there was no experience of the allocation function of commercial banking. Naturally within each monolithic communist central bank there had been departments monitoring the (planned) cash flows of various sectors of the economy, e.g. industry, agriculture, energy, transport, construction, etc., and these were then generally hived off from the parent central bank, and told to operate as commercial banks, (alongside the pre-existing specialist export/import bank). Besides these new banks, various regions, cities, or even huge State companies set up their own 'banks', not so much to allocate capital between alternative competing uses, but rather to try to funnel savings into their own operations.

In this context such 'banks' were rarely independent either of political influence or of the influences of their major borrowing clients; allocation of capital was as much due to such influence as to independent assessment of risk and return. The proportion of non-performing loans (n.p.l.s) rose to high levels. In those countries which had embraced democracy, especially in Eastern Europe, such n.p.l.s and write-offs decimated the initial set of indigenous banks, leaving the door open for the arrival of Western banks. So the majority of banking in such countries has become done by subsidiaries of foreign-owned banks.

In the countries which remained under Communist or autocratic rule, foreign banks were generally held at arms length. So the sizeable proportion of bad debts, and in numerous cases the underlying insolvency, of such banks were kept under wraps by occasional government recapitalisations (by one route or another), transfers of n.p.l.s of asset management companies (bad banks), etc. Although the comparative failure of such indigenous banks to allocate capital efficiently led to much waste, nevertheless the extraordinarily high rates of savings and investment, especially in China, led to very rapid growth, not only of the economy, but of the main 'commercial' banks, so much so that [four] of the largest ten banks in the world are now Chinese.

This story has been told by economists such as Lardy (for China), Perrotti and ?. Whereas in previous years the tone of such comment was often to compare the inefficient allocation of capital in such post-Communist banking systems unfavourably with that in the West, the continuing emergence of Chinese economic power and the recent collapse, and consequent necessary government recapitalisation, of much Western banking is leading to some reconsideration and softening of such assessments. Whereas the governance mechanism of such largely-State-controlled 'commercial banks' in the post-Communist world is not conducive to great efficiency, whether the governance mechanisms in Western banking systems are self-evidently superior is

now open to, at least some, questions. How such governance mechanisms evolve in coming decades will be for the authors of the next such Handbook to recount.

4.4 Europe and the transition to the Euro

4.4.1 Key features of the convergence process towards EMU

Figure 4.12 shows Euro area annual CPI inflation since 1971Q1,[109] and CPI inflation rates for the fifteen countries which, today, constitute European Monetary Union (henceforth, EMU),[110] together with their cross-sectional standard deviation at each point in time. After showing some signs of instability during the years leading up to the collapse of Bretton Woods, inflation rates shot up dramatically after 1971, reaching—based on synthetic aggregate Euro area-wide data—a peak of 13.6 per cent in 1974Q4. The most notable exception to the generalised inflation explosion in the Euro area was Germany, with an inflation peak of 7.8 per cent in December 1974. The second key feature of the Great Inflation episode in the Euro area is the dramatic increase in the cross-sectional dispersion of inflation rates, which reached a peak in excess of 9 per cent in the second half of the 1970s. Starting from the first half of the 1980s, the disinflation process has been characterized by a decrease in both individual countries' inflation rates, and the extent of their cross-sectional dispersion. In particular, excluding Slovenia—which until the second half of the 1990s exhibited an inflation rate in excess of 20 per cent, and was therefore a clear outlier—the cross-sectional standard deviation of inflation rates decreased from between 5 and 6 per cent at the very beginning of the 1990s to about 1 per cent at the start of EMU, and has oscillated between 0.6 and 1.6 per cent ever since.[111]

A second key feature of the convergence process towards EMU, which is extensively discussed by Ehrmann, Fratzscher, Gürkaynak, and Swanson (2007), is the convergence and anchoring of bond yield curves across the Euro area. Ehrmann, Fratzscher, Gürkaynak, and Swanson (2007), in particular, produce two types of evidence. First, an increase in the unconditional correlation between individual countries' yield curves, both in the run-up to EMU, and after January 1999. Second, an increase in the synchronisation of their conditional responses to macroeconomic announcements. Their conclusion is that

> '[. . .] the convergence process seems to have been strongest just before and after monetary union in 1999'

[109] For the period before European Monetary Union, Euro area CPI inflation has been computed based on the Area Wide Model synthetic CPI index—see Fagan, Henry, and Mestre (2005).

[110] They are Austria, Belgium, Cyprus, France, Finland, Greece, Germany, Ireland, Italy, Luxembourg, Malta, the Netherlands, Portugal, Slovenia, and Spain.

[111] After Slovenia joined EMU, on January 1, 2007, the evolution of the cross-sectional standard deviations of inflation rates including and excluding it are very similar.

thus providing clear *prima facie* evidence of the fundamental role played by (the convergence process towards) EMU in progressively anchoring yield curves across the Euro area.

4.4.2 Structural changes in the Euro area under European Monetary Union

EMU has been characterised by two key structural changes pertaining inflation dynamics.

The anchoring of long-term inflation expectations A change discussed by Ehrmann, Fratzscher, Gürkaynak, and Swanson (2007) is the anchoring of long-term inflation expectations, in the specific sense that, following January 1999, Euro area long-term bond yields exhibit little reaction in response to macroeconomic announcements. [Here discussion of US and inflation targeting countries] The most logical explanation of such phenomenon is a strong anchoring of long-term inflation expectations. In the presence of perfect anchoring of long-term inflation expectations at (say) 1.9 per cent, macroeconomic data releases—which contain valuable information for short-term developements and business-cycle frequency fluctuations—would still obviously impact upon the short end of the yield curve, but such impact would progressively decrease with an increase in the maturity, becoming equal to zero at the very long end of the yield curve.[112]

The disappearance of inflation persistence A second structural change under EMU is the (near) disappearance of inflation persistence, defined as the tendency for inflation to deviate from its unconditional mean, rather than quickly reverting to it, following a shock. After January 1999 inflation persistence has essentially vanished both (1) in a strictly *statistical* sense—as measured, e.g., by the sum of the autoregressive coefficients in estimated AR(p) models for inflation—and (2) in a *structural* sense, as captured by the indexation parameter in estimated backward- and forward-looking New Keynesian Phillips curves,[113] so that Euro area inflation can be regarded, today, as being (close to) purely forward-looking. Based on the sum of the AR coefficients in AR(p) representations for inflation, Benati (2008b) estimates Euro area inflation to have been non-stationary before EMU based on both the GDP and the consumption deflators,[114] and to have become strongly mean-reverting under EMU, with point estimates of ρ equal to 0.35 and 0.10, respectively. Further, whereas his modal estimate of the indexation parameter in backward- and forward-looking New Keynesian Phillips curves is equal to 0.864 over the full post-1970 sample, it

[112] [Here comparison with the almost complete flatness of the long-term bond yields in the U.S., U.K., etc. under the Gold Standard]

[113] See Christiano, Eichenbaum, and Evans (2005) and Smets and Wouters (2007).

[114] In both cases the point estimate of 'ρ is equal to 1.01.

is only equal to 0.026 under EMU.[115] As discussed by Benati (2008b)—see Table 1—such development does not uniquely pertain to EMU, but it is rather typical of all stable monetary regimes with clearly-defined nominal anchors, like the Classical Gold Standard and, over the most recent period, inflation targeting regimes and the post-January 2000 new Swiss 'monetary policy concept'. On the other hand, both statistical persistence, and a significant backward-looking component in hybrid New Keynesian Phillips curves, are still clearly apparent in the post-Volcker stabilization United States, which lacks a clearly-defined inflation objective, and is instead characterised by a *generic* commitment to price stability. How should we interpret this findings? Although several explanations can be offered, the simplest and most logical one is based on the notion that, in the absence of a clearly-defined and credible inflation objective, economic agents have little alternative, when forming inflation expectations, to looking at the past history of inflation, thus automatically introducing a backward-looking component in aggregate inflation dynamics. Under regimes characterised by a clearly-defined and credible inflation objective, on the other hand, agents do not need to look at the past history of inflation in order to form inflation expectations, simply because the inflation objective itself represents, to a first approximation, a reasonable inflation forecast.[116] As a result, inflation expectations will turn out to be essentially disconnected from past inflation dynamics, and *ex post* econometric analyses will identify no backward-looking component.

4.4.3 The Euro area's comparative macroeconomic performance under European Monetary Union

Figure 4.13 shows a scatterplot of the standard deviations of real GDP growth and CPI inflation for the Euro area, the United States, and several other countries[117] for the period following the start of EMU. As the table shows, during this period the Euro area has exhibited the lowest volatility of CPI inflation across all countries—although almost *ex aequo* with Japan and Switzerland—and the second lowest volatility of real GDP growth after the United Kingdom.

4.5 Financial stability and the causes of the financial crisis of 2007-9

One of Governor Mervyn King's favourite words is 'focus', and central banks indeed focussed on the achievement of low and stable inflation during these years. And they succeeded, brilliantly; but they, perhaps, forgot that financial crises have often

[115] Benati (2008b) also presents similar results for the three largest Euro area countries, Germany, France, and Italy.

[116] To put it differently, the inflation objective represents a 'focal point' for inflation expectations.

[117] We considered all countries for which the *International Monetary Fund*'s *International Financial Statistics* database contained quarterly series for both CPI inflation and real GDP growth for the period starting in the first quarter of 1999.

occurred after apparently successful periods of economic development, e.g. USA in the 1920s, Japan in 1980s, and in the 19th century after the deployment of great new innovations, such as canals and railways. There is a reason why success can breed crises, as Minsky (Ref) indicated. This is that the more successful an era, the greater the returns, and the less the risk seems to be. Anyone not joining the leverage bandwagon then was a wimp. Since 1993-2006 was such a 'golden era', the hang-over was bound to be that much greater.

Of course, there were policy mistakes, but in the field of macro-monetary policy they were relatively minor. The Fed, perhaps, over-reacted to what it perceived as the earlier errors of the bank of Japan, in not responding aggressively enough to the asset-price bust of 1990/91, (Bernanke Refs), and, with the benefit of hindsight kept official interest rates too low for too long in 2002-5 (Taylor Ref). It compounded this error by giving a public commitment to keep short rates low for some long time. While the purpose was to influence long rates, a la Woodford, an unintended side effect was to encourage financial intermediaries to pile on short term wholesale borrowing to invest in longer-term, often mortgage-backed, securities.

Yet even when all that is taken into account, our provisional conclusion, following Minsky, is that a (successful) inflation targeting regime is simply not equipped to prevent, or even greatly to mitigate, an asset price bubble and bust. In particular, as is now obvious, the idea that monetary policy can effectively tidy up after the bust, without major adverse effects on the real economy, has been shown to be wrong.

This has led to two responses; first, that the inflation targeting regimes need to be changed; second, that the monetary authorities need to be equipped with additional instrument(s) to hit this second objective, according to the Tinbergen principle. The first response runs through a whole gamut, or range of responses; from the minor, of including housing prices in the relevant inflation index and of paying more attention to the monetary aggregates, a la second pillar of the ECB, (with which we would agree); to a middle position of putting asset prices (somehow) into a central bank's reaction function; to the extreme of removing central banks' operational independence, and specified inflation targets altogether, and reverting to discretionary political control of interest rates. Particularly at a time of enhanced uncertainty about future inflation, when both deflation and high inflation appear as possible forecasts, we would be strongly opposed to this latter extreme position.

This leaves us in search of alternative macro-prudential instruments to use for the purpose of maintaining financial stability. There are at least three, involving (time and state varying) requirements, or controls, over:

1) Liquidity
2) Capital
3) Remuneration

None of these had been deployed effectively prior to the crash of 2007. We shall examine the history of each of these in turn here, before putting forward some reform proposals in the final section.

4.5.1 Liquidity

As explained earlier, Section 2x, the Basel Committee on banking Supervision had failed in its earlier attempt to reach an Accord on Liquidity in the 1980s. So, asset liquidity had been run down. The general hypothesis, shared alike by most bankers and most regulators, was that, so long as banks had 'sufficient' capital, they could always access efficient wholesale money markets, and thereby replace asset liquidity by funding liquidity. While these money markets were short-term, compared to bank assets, the interest rate and credit risks generated by such a maturity mismatch could then be resolved by securitisation and by hedging via derivatives. Finally the assumption was that adherence to Basel II would ensure 'sufficient' capital.

These comfortable assumptions fell apart in the summer of 2007. The actual, and prospective, losses on mortgage backed securities, especially on sub-primes, and the gaming of Basel II, especially by European banks, meant that adherence to the Basel II requirements was not enough to provide complete assurance on future solvency in many cases. Especially with opacity on CDOs, the markets for securitisation dried up, as did short-term wholesale markets, e.g. asset-backed commercial paper, and unsecured interbank term loan markets. This led to a liquidity crisis.

According to the prior set of assumptions, this could/should never have happened. It took everyone, including the central banks, largely by surprise. One response was that this pickle was largely the fault of the commercial banks' own business strategies, (too few 'good' public sector assets, too much reliance on short-dated wholesale funds and securitisation, too great a mismatch, etc.); so to help banks out of this hole would generate moral hazard. Perhaps, but the virulence of the collapse became so great that all the central banks were forced to expand their provision of liquidity over an ever-increasing range of maturities, collateral and institutions.

4.5.2 Capital requirements

Risk management is a complicated business, with many facets. The Basel Committee on banking Supervision (BCBS) Capital Accord of 1988 only addressed credit risk. They turned next to the subject of Market Risk, comprising interest rate risk, liquidity risk, etc., in banks' trading books. When they circulated their early discussion drafts, they soon found that their heuristic, rule-of-thumb approach to assessing such risks was technically far behind the internal risk management approach of the large international banks, who had been developing internal risk management models based on finance theory, in particular the Value-at-Risk, VaR, Model. The BCBS recognised that they were comparatively deficient in risk modelling, and in effect adopted the commercial banks' internal modelling techniques, both for the Market Risk amendment to the Basel Accord (1996) and, more important, as the basis for Basel II. In a sense the BCBS had been intellectually captured.

Basel I had soon come under fire. Its risk 'buckets' were far too broad. Any loan to a private corporate had the same (100%) weight whether to the largest/safest

company or to some fly-by-night start-up. So the regulators were requiring too much regulatory capital to be placed against 'safe' loans, and too little against 'risky' loans. This led banks to sell off 'safe' loans (securitisations) to entities outside the regulatory net – including the emerging shadow banking system – and to hold onto their risky loans. So the regulation, intended to make banks safer, was instead making them riskier. The answer seemed to be to rely more on market risk assessment, either by credit rating agencies, or, even better, by the banks themselves in either the Foundation or Advanced internal ratings based (IRB) approaches. The basic idea was to allow the regulators to piggy-back on the greater technical risk-management skills of the regulated, and one of the boasts of the authors of Basel II was that it aligned regulatory capital much more closely with the economic capital that the banks wanted to keep for their own sake.

This was, however, a misguided strategy. A commercial bank's concern is how to position itself under normal conditions, in which it can assume, even for large banks, that outside conditions will not be much affected by its own actions. If really extreme conditions do develop, the authorities will anyhow have to react. Moreover, it is unconcerned with any externalities that its failure might cause. For such purposes tools such as VaRs, stress tests, etc., are well designed. But the regulators' concerns should have been quite different. Their concern should have been exclusively about externalities, since the banks' creditors should properly absorb internalised losses. They should have worried about the strength of the system, not so much that of the individual bank, about co-variances rather than variances, about inter-active self-amplifying mechanisms rather than about stress tests that assume a world invariant to the banks' own reactions, (Brunnermeier, et al., 2009).

Why did it all go so wrong? First there was often an implicit belief that, if one acted to make all the individual components (banks) of a (banking) system operate safely, then the system as a whole would be protected from harm (fallacy of composition). Second, there was a tendency among the regulators, and at the BCBS, to patch up the system incrementally in response to criticism (and to events) rather than to think about fundamental issues. Regulators, and supervisors, tend to be pragmatists rather than theorists – and they had little enough help from economists, many of whose main models abstracted from financial intermediation and/or default!

Be that as it may, the slow, and painful, advent of Basel II did nothing to mitigate the cycle of credit expansion and taking on extra leverage, up until August 2007, and its abrupt and destructive reversal thereafter. Defaults, volatility and risk premia were all reduced to low levels (2003-6), and ratings whether by CRAs, or internally, were high and rising. With profits, and capital, further enhanced by the application of mark-to-market accounting, all the risk models, such as VaR, and market pressures were encouraging banks, and other financial intermediaries, to take on ever more leverage, right until the bottom fell out of the market in July/August 2007.

Once again the need is to rethink the mechanism and applications of capital requirements.

4.5.3 Remuneration

A slogan of the American Rifle Association (ARA) is that 'Guns don't kill people; people kill people'. By the same token one could make the same point in finance, 'Toxic assets do not kill banks; bankers kill banks'. Again, if the incentives for bankers are to take risks, then they will attempt to do so whatever the regulations may be. Most regulations can be manipulated, or 'gamed', by those who seek to do so. Basel II was manipulated, e.g. by UBS, by leveraging up on assets with a higher yield than its risk-weighting justified on the basis of a maturity mismatch. A simple leverage ratio can be manipulated by taking on riskier assets.

Much of the aim of remuneration packages in recent decades has been to align senior bank officials' incentives alongside those of shareholders, with a quite low fixed salary and generous bonuses when the bank does well. Perhaps they have succeeded too well. The convex structure of a limited liability contract, with a zero floor on the downside and unlimited upside potential, a call option on the bank, makes it sensible for bank shareholders to go for risky strategies, unless they already hold a sizeable proportion of their wealth in that bank, (which they should have diversified anyhow). Should senior bankers necessarily have the same incentives as shareholders, when externalities make the taxpayer pick up the tab for failed business strategies, (Bebchuk and Fried, 2004; Bebchuk and Spamann, 2009).

There is public concern with the pattern of remuneration for senior bankers, not so much with the high bonus payments for success (though there are worries that 'success' is achieved by hiding risk rather than by exceptional skill), but rather with their ability to walk away from failures without significant loss, and sometimes with a golden handshake or enhanced pension. The need, perhaps, is to make senior bankers' wealth a function of the continuing value of the bank over which he has presided. There are various ways whereby this might be done. For example, requiring that the proportion of own bank shares in a bank official's pension pot is positively related to seniority (100% for CEO to 0% for bank clerk). Or requiring that all bank officials beyond a certain level of seniority have to accept a single non-transferable unlimited liability share.

But is there any evidence that bank CEOs which had more of their own wealth tied up in their own bank were any more cautious? Perhaps a requirement for becoming a senior bank manager is a willingness to take on risks enhanced by the conviction that one will always get it right. Do bank CEOs have a tendency to self-assured arrogance? Is that a requirement for the success of Schumpeterian capitalism? How could one instil self-doubt into a Richard Fuld[118] or a Fred Goodwin?

Concern with the remuneration of financial regulators is rather different. Too often they are paid too little either to attract good new entrants or to retain skilled

[118] Fuld was well known for his extraordinary aggressiveness (even by Wall Street standards ...), which earned him the sobriquet 'the Gorilla'. One of his best-known quotations—as reported by Stefan Stern (2009)—is: 'When I find a short seller, I want to tear his heart out and eat it before his eyes while he's still alive.'

staff. Again it is difficult to assess value added amongst regulators and supervisors, so it is hard to reward success or to provide performance pay.

On the whole regulators, and politicians, have shied away from addressing such concerns about remuneration. Trying to intervene could be easily mishandled and could be explosively dangerous. Yet the way in which remuneration is set does depend on the legal and cultural infrastructure, which is a matter for policy, and the present state of affairs is not self-evidently satisfactory. Maybe future regulators will feel the need to grasp this nettle.

4.6 The evolution of risk premia: evidence for the United States

An important piece of evidence on (the origins of) the financial crisis is provided by the evolution of risk premia. As we previously mentioned in Section 4.1.1, the Great Moderation era which immediately preceded the 2007-2009 financial crisis had been characterised by a remarkable decrease in macroeconomic uncertainty across the board, in terms of significant falls in the standard deviations of k-step ahead projections for key variables such as inflation and output growth. To the extent that this decrease in macroeconomic uncertainty mapped into

(i) a mistaken *perception* that the world was *way* safer than economic agents had previously thought, and therefore, as a consequence,

(ii) an increased appetite for risk and a compression of risk premia,

this may logically be thought to have contributed to inflating the bubbles that ultimately brought financial markets down. *Prima facie* evidence in favor of this interpretation would be provided by empirical evidence on the compression of risk premia during the Great Moderation period. We therefore turn to estimating risk premia for stocks, bonds, and the housing market for the United States.[119]

We compute stocks, bonds, and housing risk premia *via* the VAR-based methodology proposed by Campbell and Shiller (1988a) and Campbell and Shiller (1988b), with the only difference that, in the spirit of DeSantis (2007), we apply it to the time-varying parameters VAR (4)-(12), rather than to a fixed-coefficients VAR. In what follows we describe the methodology for the stock market,[120] but with obvious changes of variables[121] the very same method identically applies to the other two markets.

Let Y_t in (4) be defined as $Y_t \equiv [\delta_t,\ (\Delta d_t\text{-}r_t^f),\ \pi_t,\ y_t]'$, with δ_t, Δd_t, and r_t^f being the logarithm of the dividend/price ratio, the log-difference of the dividend,

[119] Our exclusive focus on the United States is uniquely motivated by reasons of data availability and data quality.

[120] The description closely follows DeSantis (2007).

[121] For the housing market, the rent instead of the dividend, and the rent/price ratio instead of the dividend/price ratio. For the bond market, a fixed coupon normalised to one dollar, instead of the dividend, and the long-term interest rate instead of the dividend/price ratio.

and the risk-free rate, respectively, and with π_t and y_t being inflation and output grow'th. (For a description of the data and of the sample periods, see Appendix A). Let $d_t \equiv \ln(D_t)$ and $p_t \equiv \ln(P_t)$, so that $\delta_t = d_t - p_t = \ln(D_t) - \ln(P_t)$. By defining the gross return on stocks as

$$h_{t+1} \equiv 1 + R_{t+1} = \frac{P_{t+1} + D_{t+1}}{P_{t+1}} \tag{21}$$

we have, after some algebra, that

$$h_{t+1} \equiv \delta_t - \delta_{t+1} + \Delta d_{t+1} + \ln\left[1 + \exp\left(\delta_{t+1}\right)\right] \tag{22}$$

Following Campbell and Shiller (1988*a*, *b*), and taking a first-order Taylor expansion of (22) around the unconditional mean $\bar{\delta}_t$, we have

$$h_{t+1} - r^f_{t+1} \simeq \bar{\kappa}_t + \delta_t + \left(\Delta d_{t+1} - r^f_{t+1}\right) - \bar{\rho}_t \delta_{t+1} \tag{23}$$

where $\bar{\rho}_t \equiv [1 + \exp(\bar{\delta}_t)]^{-1}$, and $\bar{\kappa}_t \equiv -\bar{\rho}_t \ln(\bar{\rho}_t) - (1-\bar{\rho}_t)\ln(1-\bar{\rho}_t)$, which implies

$$\delta_t \simeq -\frac{\bar{\kappa}_t}{1-\bar{\rho}_t} + \sum_{j=0}^{\infty} \bar{\rho}_t^j (h_{t+1+j|t} - r^f_{t+1+j|t}) - \sum_{j=0}^{\infty} \bar{\rho}_t^j (\Delta d_{t+1+j|t} - r^f_{t+1+j|t}) \tag{24}$$

The conditional equity premium, $EP_{c,t}$, is therefore approximately equal to

$$EP_{c,t} \equiv (1-\bar{\rho}_t) \sum_{j=0}^{\infty} \bar{\rho}_t^j (h_{t+1+j|t} - r^f_{t+1+j|t}) \simeq$$

$$\simeq \bar{\kappa}_t + \delta_t (1-\bar{\rho}_t) + (1-\bar{\rho}_t) \sum_{j=0}^{\infty} \bar{\rho}_t^j (\Delta d_{t+1+j|t} - r^f_{t+1+j|t})$$

$$\simeq \bar{\kappa}_t + \delta_t (1-\bar{\rho}_t) + (1-\bar{\rho}_t) s_2 \left(I - \bar{\rho}_t A_t\right)^{-1} \tilde{Y}_t \tag{25}$$

where A_t is the companion matrix of the VAR, $\tilde{Y}_t \equiv [Y_t', Y_{t-1}']'$, and s_2 is a selector vector that extracts the second element from $\tilde{Y}_t$.

For each draw of the ergodic distribution generated by the Gibbs sampler, the conditional equity premium can then be trivially computed based on (25) and the VAR representation (4).

Figure 4.14 shows the results from this exercise. Both the dotcom bubble of the second half of the 1990s, and the housing bubble of the beginning of the XXI century, have been accompanied by clear compressions of the respective risk premia, thus providing ammunition to those who maintain that mistaken perceptions about the true underlying extent of riskiness of the economy do explain at least part of the bubble episodes.

5 The Financial Crisis, 2007-9

> Those of us who have looked to the self-interest of lending institutions to protect shareholders' equity, myself included, are in a state of shocked disbelief.
>
> —Alan Greenspan[122]

5.1 'Why did no one warn us about this?'

The golden age of central banking came to a shuddering halt on August 9th, 2007, when wholesale and interbank markets began to shut down, leading to a sharp withdrawal of liquidity from the system and a spike in credit risk premia. The proximate cause was the broad decline in housing prices across the USA, leading to rising delinquency rates on sub-prime mortgages, and growing doubts and uncertainties about the valuations of mortgage backed securities. On August 9 BNP Paribas suspended the calculation of asset values for three money market funds exposed to subprime, and halted redemptions. In view of the withdrawal of liquidity, the ECB injected 95 billion euro overnight, alerting the world to the existence of a major problem.

When opening a new building at the London School of Economics (LSE) in 2008, the Queen asked an attendant LSE economist, "Why did no one warn us about this?" While a perfectly understandable question to ask, (and has since become famous), it is, on this view, nevertheless misguided. Crises are, almost by definition, unexpected. If it had been expected, it would have been prevented, which is one reason why 'early warning systems' (beloved by politicians) are mostly a waste of time. Most really large financial crises have emerged after a period of successful economic development (USA in the 1920s, Japan in the 1980s); in the 19th century innovations, e.g. canals, railroads, led to expansion, overbuilding and then crisis. The Minsky thesis that stability carries with it the seed of subsequent instability (Minsky 1977 and 1982) fits the picture.

There is an alternative, but not mutually exclusive, hypothesis, that inflation was (somewhat artificially) held down by the entry of China into world markets, and that the Fed kept its official rates too low over the years, 2002-5, partly as a result of the global 'imbalances'. The argument goes, see Taylor (2009), that had official rates been raised quicker, the housing boom, and the associated credit expansion, would never have developed so far, and could have been deflated much more safely. Perhaps, but given the low and stable rates of (core) inflation in the USA, and other Western economies, (and the fears of Japanese-style deflation), it would have been (politically) difficult to have raised official interest rates out of fear about the potential future effects of credit expansion, monetary growth and housing prices. Only the ECB with its second monetary pillar took steps in this direction in 2004/5. Moreover, there are

[122] As quoted in Paul Andrews (2008).

always persuasive voices to claim that debt/income ratios, leverage ratios, housing prices, credit expansion, etc., etc., are perfectly sustainable.

The dominant argument (Bernanke, Gali and Gilchrist check) was that the monetary authorities could, and should, only respond to asset price movements in so far as they could be forecast to affect future output and inflation. If a bubble did burst, then the authorities could, and should, pick up the pieces afterwards by suitably aggressive counter-cyclical adjustments of official short-term interest rates. Moreover, this latter policy had seemed to work, in October 1987, October 1998 and 2001/2. Indeed, the credibility of the Fed in protecting the system against the adverse effects of financial collapses, often termed the 'Greenspan put', was itself a factor leading to the underpricing of financial risk, and the expansion of leverage, in these years (2002-7).

6 Implications for Future central bank Policies?

Many, e.g. Cecchetti *et al.* (200x), have argued that inflation targeting (whereby official interest rates are adjusted primarily to keep future inflation in line with target), is simplistic, despite its manifold attractions, e.g. accordance with Tinbergen principles and great success in the NICE years (1992-2007). Instead, they suggest that interest rates should 'lean against the wind' of asset price fluctuations. We disagree if that is defined as 'targeting' or 'trying to influence asset prices'. Indeed, the furthest that one might want to go in this direction is to appreciate the virtues of the ECB's second monetary pillar. From a central bank viewpoint it has the virtues of relating policy to monetary aggregates, which, unlike housing or equity prices, are in the locus of monetary policy. Moreover, massive credit and leverage expansion is likely, (but not, alas, certain), to show up in such monetary data – unless hidden in the 'shadow banking system'.

But, if official interest rate adjustment is, to continue, to be dedicated to the macro-economic purpose of maintaining price stability, then how are central banks to achieve their concern with maintaining orderly financial conditions as a pre-condition to maintainance of price stability, now that that role has become so prominent? At present (2009), the powers of most central banks in this field are limited to 'delivering sermons and organizing burials', King (2009) [check source] [sermons in financial stability Reviews on the need for prudence; burials of imprudent financial intermediaries].

So, the search is on, at least in some quarters, for a second (set of) instrument(s), macro-prudential counter-cyclical instruments, which may be wielded by central banks, alongside and independently of official interest rates. There are a variety of proposals in this field, ranging from the Spanish dynamic pre-provisioning scheme, through (possibly time-varying) leverage ratios, to counter-cyclical capital requirements.

There are objections to such proposals to give central banks such additional powers

in some quarters, mostly emanating from the USA. It is argued either that such extra powers could be made unnecessary by forcing systemic financial intermediaries to self-insure and/or that any such instruments to maintain financial stability should be vested in a body other than the central bank.

In part this latter argument derives from an appreciation that financial stability issues are inherently more administratively complex, than monetary policy. As has been demonstrated, the resolution of serious financial crises will involve the injection of taxpayer moneys. That means that the Treasury must play a role, perhaps a minor role under normal circumstances, but the lead role during crisis resolution. Moreover, few central banks would want to undertake the main micro-supervision role in the financial system themselves. That means that financial stability issues ultimately have to be decided by some kind of tripartite financial stability Committee (FSC).

The question then arises whether, and how far, the involvement of a central bank in such a Committee might raise questions about its independence in the monetary policy field? The adoption of unconventional measures by central banks, e.g. in the guise of quantitative credit (Fed) or monetary easing (BoE), has already underlined the necessarily close interactions between monetary and fiscal policies. Exit policies from the present combination of massively expansionary fiscal and monetary policies are likely to involve complex problems of timing, sequence and control. In this context the independence of the central bank and its constitutional role are quite likely to become subject to renewed questioning.

There is a particular problem about the relative roles of the ECB and the NCBs in the eurozone. There is no federal Treasury there; so how can one organize a euro-zone tripartite committee? On the other hand leaving financial stability to the member states, as has happened de facto now, while having the ECB run a centralised monetary policy, is neither comfortable nor communautaire. No solution is yet in sight.

This underscores a wider point, that laws and governments (and central banks) are national, whereas the financial system is global, and almost all the large financial intermediaries are cross-border, "international in life, but national in death". There are two obvious alternatives. First, one can try to make the key laws, especially insolvency laws for systemic financial intermediaries, and governance and regulation mechanisms, e.g. via the FSB and BCBS, international. But would the US Congress accept a law drafted by foreigners; would the Europeans accept whatever regulatory policies that the USA finally agrees? And the Rest of the World? Failing that, and failure does seem the most likely outcome, the other logical solution is to give regulatory control back to the host countries, causing frictions to the global financial system, and making cross-border banks effectively into holding companies for separate national banks. Since neither outcome is palatable, the probable result will be muddle and confusion.

Just a scant couple of years ago, the role and constitutional position of central banks seemed assured. They should be independent (within the public sector), and

deploy their single instrument of interest rates primarily to achieve a low and stable inflation rate. In so far as financial disturbance threatened the macro-economic outlook, a judicious but determined adjustment of interest rates could pick up the pieces. And it worked, brilliantly and successfully, for some 15 years, or so. But now the financial crisis has re-opened old questions and raised new ones; prior certainties have been flushed away. How these questions may be answered, will be the subject of a similar Chapter in the next Handbook.

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A The Data

[Here details on the dataset]

B Details of the Bayesian Procedure for the Estimation of the Time-Varying Parameters VARs

We estimate model (4)-(12) *via* Bayesian methods. The next two subsections describe our choices for the priors, and the Markov-Chain Monte Carlo algorithm we use to simulate the posterior distribution of the hyperparameters and the states conditional on the data, while the third section discusses how we check for convergence of the Markov chain to the ergodic distribution.

B.1 Priors

For the sake of simplicity, the prior distributions for the initial values of the states—θ_0, α_0, and h_0—which we postulate all to be normal, are assumed to be independent both from one another, and from the distribution of the hyperparameters. In order to calibrate the prior distributions for θ_0, α_0 and h_0 we estimate a time-invariant version (4) based on the first 8 years of data, and we set

$$\theta_0 \sim N\left[\hat{\theta}_{OLS}, 4 \cdot \hat{V}(\hat{\theta}_{OLS})\right] \tag{B.1}$$

As for α_0 and h_0 we proceed as follows. Let $\hat{\Sigma}_{OLS}$ be the estimated covariance matrix of ϵ_t from the time-invariant VAR, and let C be the lower-triangular Choleski factor of $\hat{\Sigma}_{OLS}$—i.e., $CC' = \hat{\Sigma}_{OLS}$. We set

$$\ln h_0 \sim N(\ln \mu_0, 10 \times I_4) \tag{B.2}$$

where μ_0 is a vector collecting the logarithms of the squared elements on the diagonal of C. We then divide each column of C by the corresponding element on the diagonal—let's call the matrix we thus obtain $\tilde{C}$—and we set

$$\alpha_0 \sim N[\tilde{\alpha}_0, \tilde{V}(\tilde{\alpha}_0)] \tag{B.3}$$

where $\tilde{\alpha}_0$—which, for future reference, we define as $\tilde{\alpha}_0 \equiv [\tilde{\alpha}_{0,11}, \tilde{\alpha}_{0,21}, ..., \tilde{\alpha}_{0,61}]'$—is a vector collecting all the non-zero and non-one elements of $\tilde{C}^{-1}$ (i.e, the elements below the diagonal), and its covariance matrix, $\tilde{V}(\tilde{\alpha}_0)$, is postulated to be diagonal, with each individual (j,j) element equal to 10 times the absolute value of the corresponding j-th element of $\tilde{\alpha}_0$. Such a choice for the covariance matrix of α_0 is clearly arbitrary, but is motivated by our goal to scale the variance of each individual element of α_0 in such a way as to take into account of the element's magnitude.

Turning to the hyperparameters, we postulate independence between the parameters corresponding to the three matrices Q, S, and Z—an assumption we adopt uniquely for reasons of convenience—and we make the following, standard assumptions. The matrix Q is postulated to follow an inverted Wishart distribution,

$$Q \sim IW\left(\bar{Q}^{-1}, T_0\right) \tag{B.4}$$

with prior degrees of freedom T_0 and scale matrix $T_0\bar{Q}$. In order to minimize the impact of the prior, thus maximizing the influence of sample information, we set T_0 equal to the minimum value allowed, the length of θ_t plus one. As for $\bar{Q}$, we calibrate it as $\bar{Q}= \gamma \times \hat{\Sigma}_{OLS}$, setting γ=3.5×10^{-4}, the same value used by Cogley and Sargent (2005).

The three blocks of S are assumed to follow inverted Wishart distributions, with prior degrees of freedom set, again, equal to the minimum allowed, respectively, 2, 3 and 4:

$$S_1 \sim IW\left(\bar{S}_1^{-1}, 2\right) \tag{B.5}$$

$$S_2 \sim IW\left(\bar{S}_2^{-1}, 3\right) \tag{B.6}$$

$$S_3 \sim IW\left(\bar{S}_3^{-1}, 4\right) \tag{B.7}$$

As for $\bar{S}_1$, $\bar{S}_2$ and $\bar{S}_3$, we calibrate them based on $\tilde{\alpha}_0$ in (A.3) as $\bar{S}_1$=10^{-3} × $|\tilde{\alpha}_{0,11}|$, $\bar{S}_2$=10^{-3}×diag($[|\tilde{\alpha}_{0,21}|, |\tilde{\alpha}_{0,31}|]'$) and $\bar{S}_3$=10^{-3}×diag($[|\tilde{\alpha}_{0,41}|, |\tilde{\alpha}_{0,51}|, |\tilde{\alpha}_{0,61}|]'$). Such a calibration is consistent with the one we adopted for Q, as it is equivalent to setting $\bar{S}_1$, $\bar{S}_2$ and $\bar{S}_3$ equal to 10^{-4} times the relevant diagonal block of $\tilde{V}(\tilde{\alpha}_0)$ in (A.3). Finally, as for the variances of the stochastic volatility innovations, we follow Cogley and Sargent (2002, 2005) and we postulate an inverse-Gamma distribution for the elements of Z,

$$\sigma_i^2 \sim IG\left(\frac{10^{-4}}{2}, \frac{1}{2}\right) \tag{B.8}$$

B.2 Simulating the posterior distribution

We simulate the posterior distribution of the hyperparameters and the states conditional on the data *via* the following MCMC algorithm, combining elements of Primiceri (2005) and Cogley and Sargent (2002, 2005). In what follows, x^t denotes the entire history of the vector x up to time t—i.e. $x^t \equiv [x_1', x_2', \quad, x_t']'$—while T is the sample length.

(a) Drawing the elements of θ_t Conditional on Y^T, α^T, and H^T, the observation equation (4) is linear, with Gaussian innovations and a known covariance matrix. Following Carter and Kohn (2004), the density $p(\theta^T|Y^T, \alpha^T, H^T, V)$ can be factored as

$$p(\theta^T|Y^T, \alpha^T, H^T, V) = p(\theta_T|Y^T, \alpha^T, H^T, V) \prod_{t=1}^{T-1} p(\theta_t|\theta_{t+1}, Y^T, \alpha^T, H^T, V) \tag{B.9}$$

Conditional on α^T, H^T, and V, the standard Kalman filter recursions nail down the first element on the right hand side of (B.9), $p(\theta_T|Y^T, \alpha^T, H^T, V) = N(\theta_T, P_T)$, with P_T being the precision matrix of θ_T produced by the Kalman filter. The remaining elements in the factorization can then be computed via the backward recursion algorithm found, e.g., in Kim and Nelson (2000), or Cogley and Sargent (2005, appendix B.2.1). Given the conditional normality of θ_t, we have

$$\theta_{t|t+1} = \theta_{t|t} + P_{t|t}P^{-1}_{t+1|t}\left(\theta_{t+1} - \theta_t\right) \tag{B.10}$$

$$P_{t|t+1} = P_{t|t} - P_{t|t}P^{-1}_{t+1|t}P_{t|t} \tag{B.11}$$

which provides, for each t from T-1 to 1, the remaining elements in (B.9), $p(\theta_t|\theta_{t+1}, Y^T, \alpha^T, H^T, V) = N(\theta_{t|t+1}, P_{t|t+1})$. Specifically, the backward recursion starts with a draw from $N(\theta_T, P_T)$, call it $\tilde{\theta}_T$ Conditional on $\tilde{\theta}_T$, (A.10)-(A.11) give us $\theta_{T-1|T}$ and $P_{T-1|T}$, thus allowing us to draw $\tilde{\theta}_{T-1}$ from $N(\theta_{T-1|T}, P_{T-1|T})$, and so on until t=1.

(b) Drawing the elements of α_t Conditional on Y^T, θ^T, and H^T, following Primiceri (2005), we draw the elements of α_t as follows. Equation (4) can be rewritten as $A_t\tilde{Y}_t \equiv A_t(Y_t\text{-}X_t'\theta_t) = A_t\epsilon_t \equiv u_t$, with $\text{Var}(u_t)$=H_t, namely

$$\tilde{Y}_{2,t} = -\alpha_{21,t}\tilde{Y}_{1,t} + u_{2,t} \tag{B.12}$$

$$\tilde{Y}_{3,t} = -\alpha_{31,t}\tilde{Y}_{1,t} - \alpha_{32,t}\tilde{Y}_{2,t} + u_{3,t} \tag{B.13}$$

$$\tilde{Y}_{4,t} = -\alpha_{41,t}\tilde{Y}_{1,t} - \alpha_{42,t}\tilde{Y}_{2,t} - \alpha_{43,t}\tilde{Y}_{3,t} + u_{4,t} \tag{B.14}$$

—plus the identity $\tilde{Y}_{1,t} = u_{1,t}$—where $[\tilde{Y}_{1,t},\ \tilde{Y}_{2,t}, \tilde{Y}_{3,t}, \tilde{Y}_{4,t}]' \equiv \tilde{Y}_t$. Based on the observation equations (B.12)-(B.14), and the transition equation (10), the elements of α_t can then be drawn by applying the same algorithm we described in the previous paragraph separately to (B.12), (B.13) and (B.14). The assumption that S has the block-diagonal structure (12) is in this respect crucial, although, as stressed by Primiceri (2005, Appendix D), it could in principle be relaxed.

(c) Drawing the elements of H_t Conditional on Y^T, θ^T, and α^T, the orthogonalised innovations $u_t \equiv A_t(Y_t\text{-}X_t'\theta_t)$, with $\text{Var}(u_t)$=H_t, are observable. Following Cogley and Sargent (2002), we then sample the $h_{i,t}$'s by applying the univariate algorithm of Jacquier, Polson, and Rossi (1994) element by element.[123]

(d) Drawing the hyperparameters Finally, conditional on Y^T, θ^T, H^T, and α^T, the innovations to θ_t, α_t, the $h_{i,t}$'s are observable, which allows us to draw the hyperparameters—the elements of Q, S_1, S_2 S_3, and the σ_i^2—from their respective distributions.

Summing up, the MCMC algorithm simulates the posterior distribution of the states and the hyperparameters, conditional on the data, by iterating on (a)-(d). We use a burn-in period of 50,000 iterations to converge to the ergodic distribution, and

[123] For details, see Cogley and Sargent (2005, Appendix B.2.5).

after that we run 10,000 more iterations sampling every 10th draw in order to reduce the autocorrelation across draws.[124]

C Computing Generalised Impulse-Response Functions

This appendix describes the Monte Carlo integration procedure we use in section 4.1.1 to compute generalised IRFs to a monetary policy shock. For every quarter t we perform the following procedure 1,000 times.

Randomly draw the current state of the economy at time t from the Gibbs sampler's output. Given the current state of the economy, repeat the following procedure 100 times. Draw four independent $N(0, 1)$ variates—the four structural shocks—and based on the relationship $\epsilon_t = A_{0,t}e_t$, with $e_t \equiv [e_t^M, e_t^D, e_t^S, e_t^{MD}]'$, where e_t^M, e_t^D, e_t^S, and e_t^{MD} are the monetary policy, demand non-policy, supply, and money demand structural shocks, respectively, compute the reduced-form shocks ϵ_t at time t. Simulate both the VAR's time-varying parameters, the θ_t, and the covariance matrix of its reduced-form innovations, Ω_t, 20 quarters into the future. Based on the simulated Ω_t, randomly draw reduced-form shocks from t+1 to t+20. Based on the simulated θ_t, and on the sequence of reduced-form shocks from t to t+20, compute simulated paths for the endogenous variables. Call these simulated paths as $\hat{X}_{t,t+20}^{\ j}$, $j = 1, .., 100$. Repeat the same procedure 100 times based on exactly the same simulated paths for the VAR's time-varying parameters, the θ_t; the same reduced-form shocks at times t+1 to t+20; and the same structural shocks e_t^D, e_t^S, and e_t^{MD} at time t, but setting e_t^M to one. Call these simulated paths as $\tilde{X}_{t,t+20}^{\ j}$. For each of the 100 iterations define $irf_{t,t+20}^{\ j} \equiv \hat{X}_{t,t+20}^{\ j} - \tilde{X}_{t,t+20}^{\ j}$. Finally, compute each of the 1,000 generalised IRFs as the mean of the distribution of the $irf_{t,t+20}^{\ j}$'s.

D Bayesian Estimation of the New Keynesian Model of Section 4.1.2

We estimate (16)-(20) *via* Bayesian methods. The next two-sub-appendices describe the priors, and the Markov-Chain Monte Carlo algorithm we use to get draws from the posterior.

D.1 Priors

Following, e.g., Lubik and Schorfheide (2004) and An and Schorfheide (2007), all structural parameters are assumed, for the sake of simplicity, to be *a priori* indepen-

[124] In this we follow Cogley and Sargent (2005). As stressed by Cogley and Sargent (2005), however, this has the drawback of 'increasing the variance of ensemble averages from the simulation'.

dent from one another. Table 1 reports the parameters' prior densities, together with two key objects characterising them, the mode and the standard deviation.

D.2 Getting draws from the posterior *via* Random-Walk Metropolis

We numerically maximise the log posterior—defined as $\ln L(\theta|Y) + \ln P(\theta)$, where θ is the vector collecting the model's structural parameters, $L(\theta|Y)$ is the likelihood of θ conditional on the data, and $P(\theta)$ is the prior—*via* simulated annealing. We implement the simulated annealing algorithm of Corana, Marchesi, Martini, and Ridella (1987) as described in Appendix D.1 of Benati (2008b). We then generate draws from the posterior distribution of the model's structural parameters *via* the Random Walk Metropolis (henceforth, RWM) algorithm as described in, e.g., An and Schorfheide (2007). In implementing the RWM algorithm we exactly follow An and Schorfheide (2006, Section 4.1), with the single exception of the method we use to calibrate the covariance matrix's scale factor—the parameter c below—for which we follow the methodology described in Appendix D.2 of Benati (2008b) in order to get a fraction of accepted draws close to the ideal one (in high dimensions) of 0.23.[125]

Let then $\hat{\theta}$ and $\hat{\Sigma}$ be the mode of the maximised log posterior and its estimated Hessian, respectively.[126] We start the Markov chain of the RWM algorithm by drawing $\theta^{(0)}$ from $N(\hat{\theta},\ c^2\hat{\Sigma})$. For $s = 1,\ 2,\ ...,\ N$ we then draw $\tilde{\theta}$ from the proposal distribution $N(\theta^{(s-1)},\ c^2\hat{\Sigma})$, accepting the jump (i.e., $\theta^{(s)} = \tilde{\theta}$) with probability min $\{1,\ r(\theta^{(s-1)},\ \theta|Y)\}$, and rejecting it (i.e., $\theta^{(s)} = \theta^{(s-1)}$) otherwise, where

$$r(\theta^{(s-1)}, \theta|Y) = \frac{L(\theta|Y)\ P(\theta)}{L(\theta^{(s-1)}|Y)\ P(\theta^{(s-1)})}$$

We run a burn-in sample of 200,000 draws which we then discard. After that, we run a sample of 500,000 draws, keeping every draw out of 100 in order to decrease the draws' autocorrelation.

[125] See Gelman, Carlin, Stern, and Rubin (1995).

[126] We compute $\hat{\Sigma}$ numerically as in An and Schorfheide (2007).

Table 1 Prior distributions for the Ascari and Ropele's (2007) model's structural parameters

Parameter	Domain	Density	Mode	Standard deviation
θ-1	$\mathbb{R}^+$	Gamma	10	5
α	[0, 1)	Beta	0.588	0.02
ϵ	[0, 1]	Uniform	–	0.2887
σ	$\mathbb{R}^+$	Gamma	2	1
δ	[0, 1]	Uniform	–	0.2887
σ_R^2	$\mathbb{R}^+$	Inverse Gamma	0.5	5
σ_π^2	$\mathbb{R}^+$	Inverse Gamma	0.5	5
σ_y^2	$\mathbb{R}^+$	Inverse Gamma	0.5	5
σ_s^2	$\mathbb{R}^+$	Inverse Gamma	0.1	0.1
ρ	[0, 1)	Beta	0.8	0.1
ϕ_π	$\mathbb{R}^+$	Gamma	1	0.5
ϕ_y	$\mathbb{R}^+$	Gamma	0.1	0.25
ρ_R	[0, 1)	Beta	0.25	0.1
ρ_y	[0, 1)	Beta	0.25	0.1

Table 2 Prior and posterior probabilities of determinacy for the 1970s

Country	*Prior probability:* with $\bar{\pi} = 0$	*Prior probability:* with actual $\bar{\pi}$	*Posterior probability:*
United States	0.50	0.45	0.01
Euro area	0.50	0.41	0.04
Japan	0.50	0.44	0.30
United Kingdom	0.50	0.37	0
Canada	0.50	0.43	0.87
Australia	0.50	0.40	0

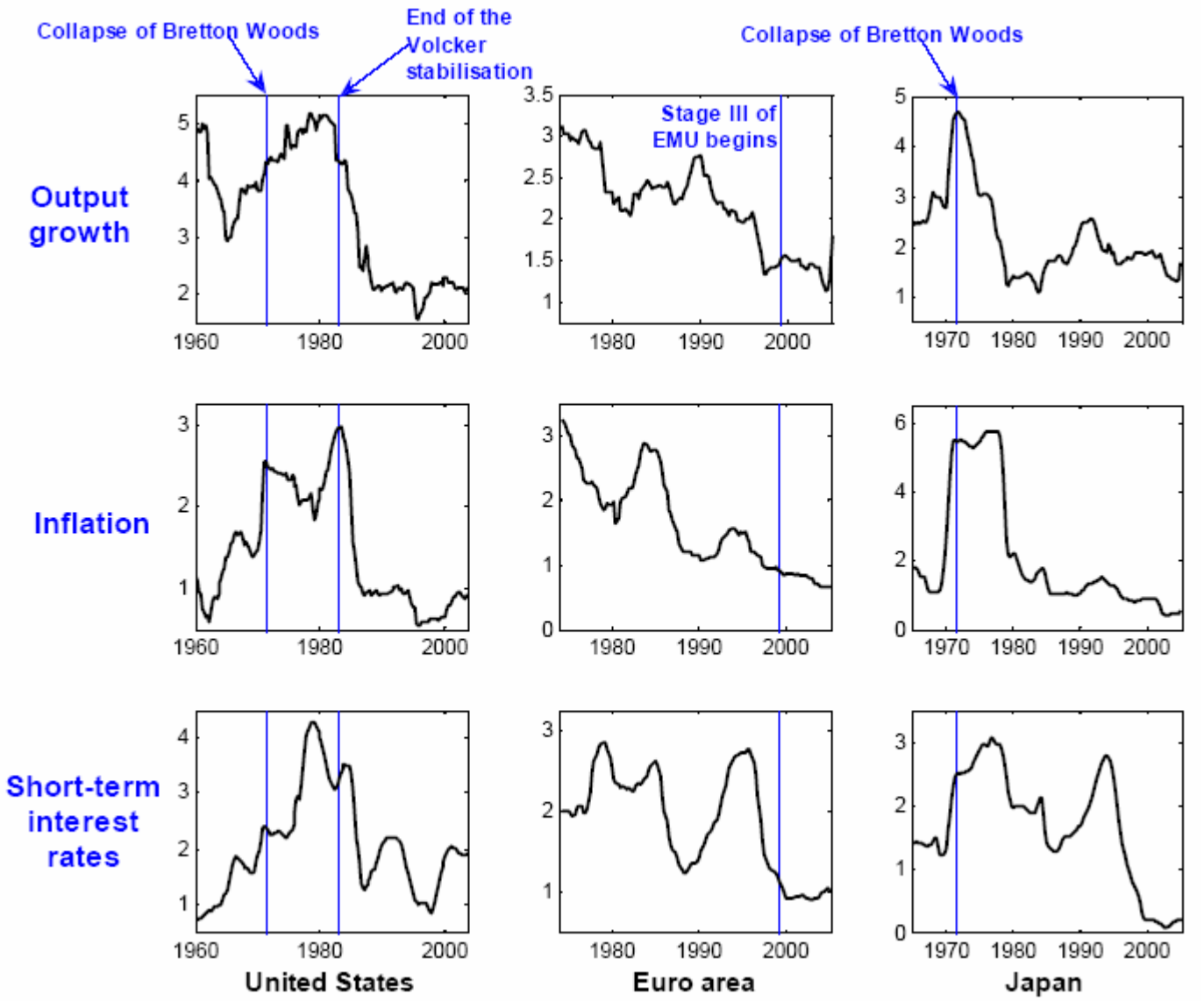

Figure 1.1 Rolling standard deviations of output growth, inflation and short-term interest rates in the United States, the Euro area, and Japan (centered 8-year rolling samples)

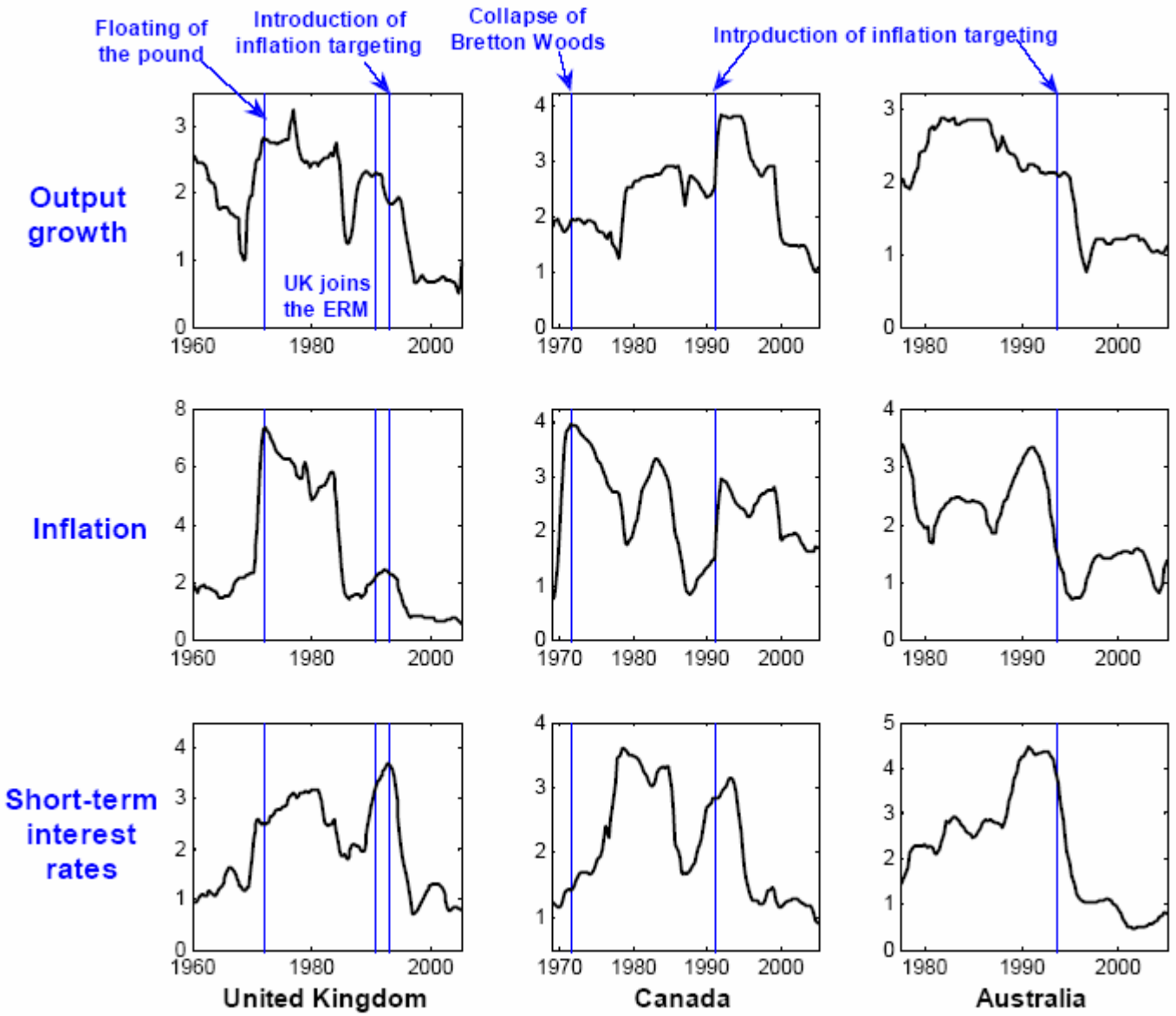

Figure 1.1 (continued) Rolling standard deviations of output growth and inflation in the United Kingdom, Canada, and Australia (centered 8-year rolling samples)

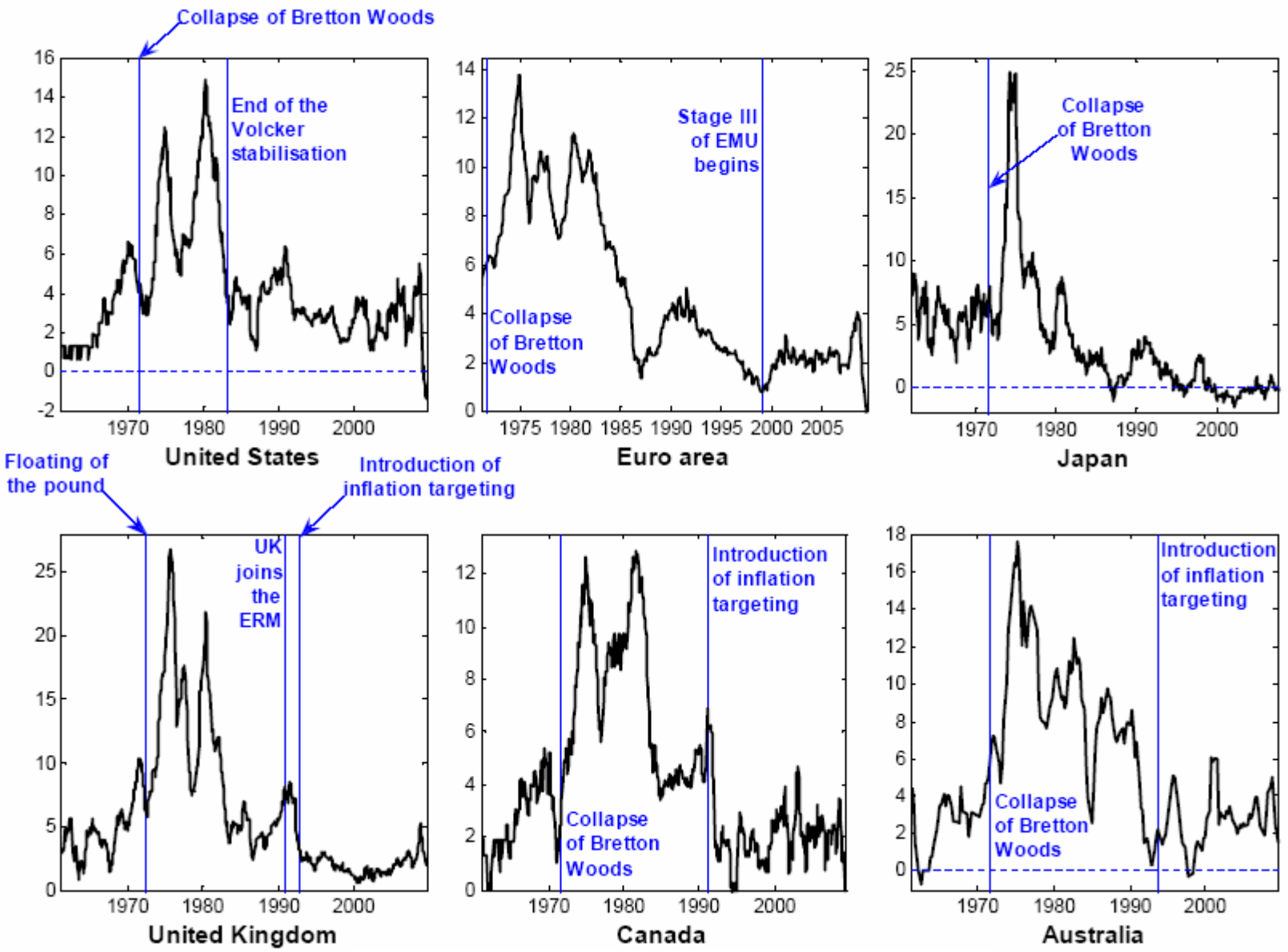

Figure 1.2 Annual CPI inflation rates

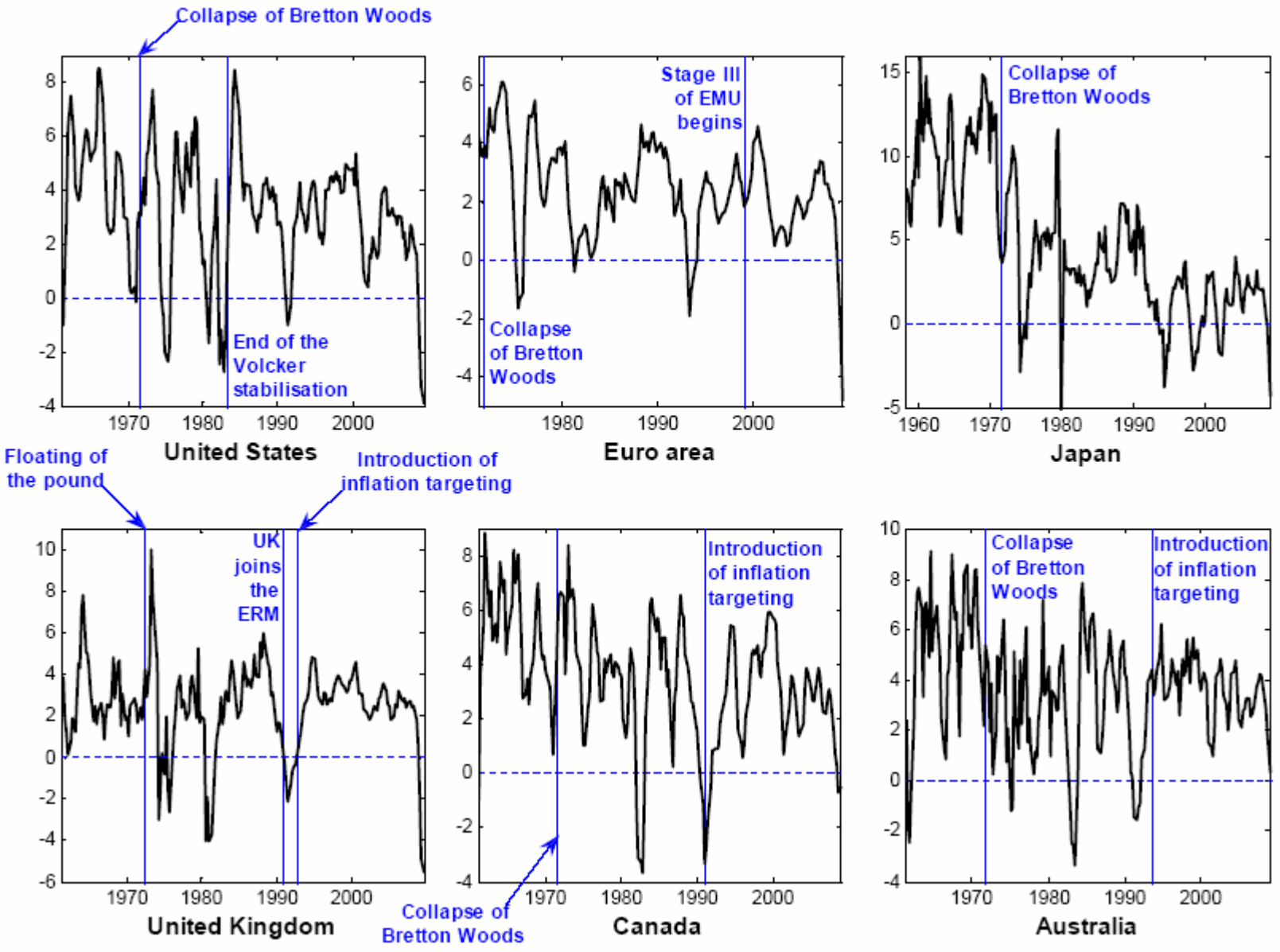

Figure 1.3 Annual real GDP growth

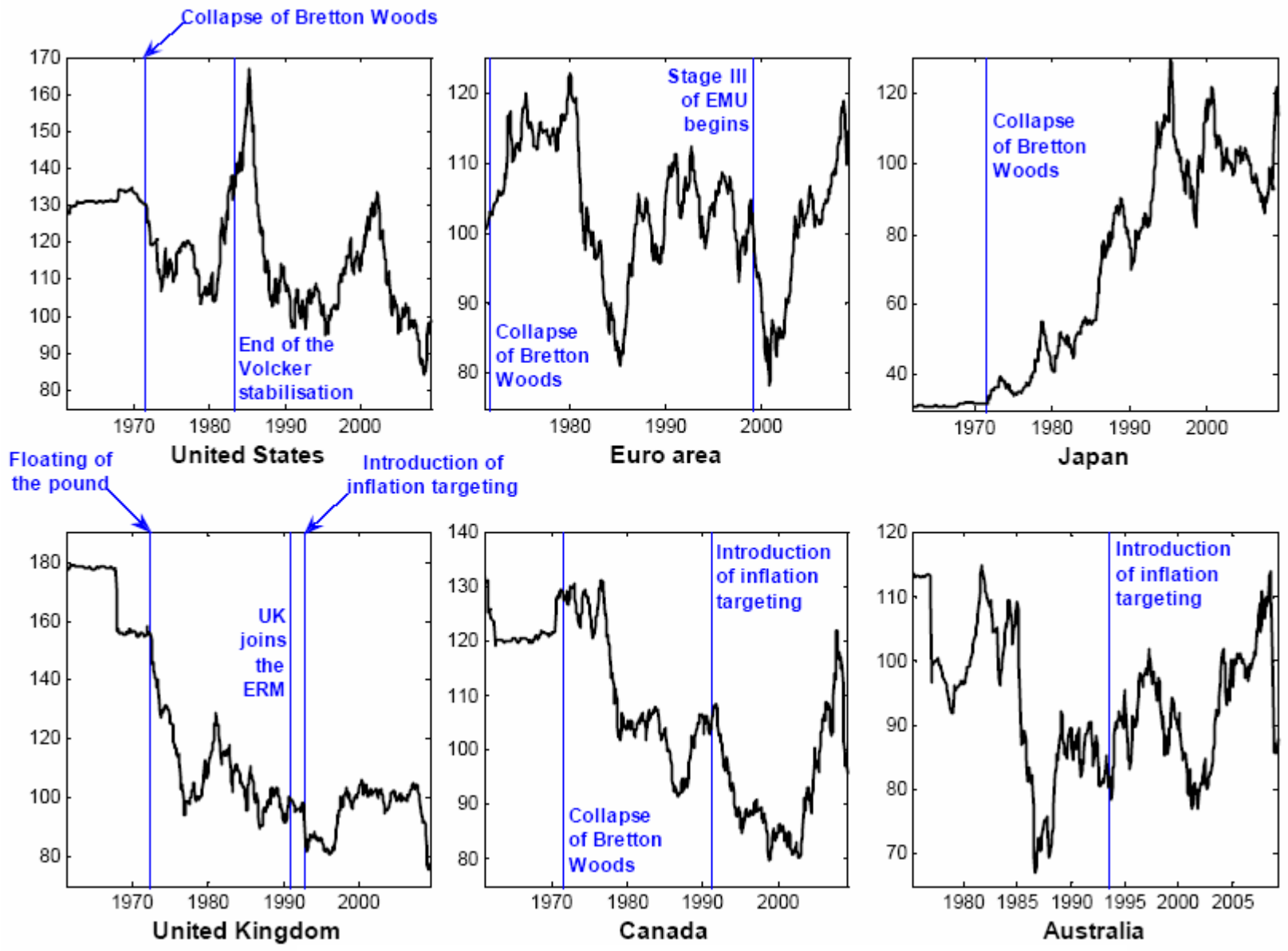

Figure 1.4 Nominal effective exchange rates

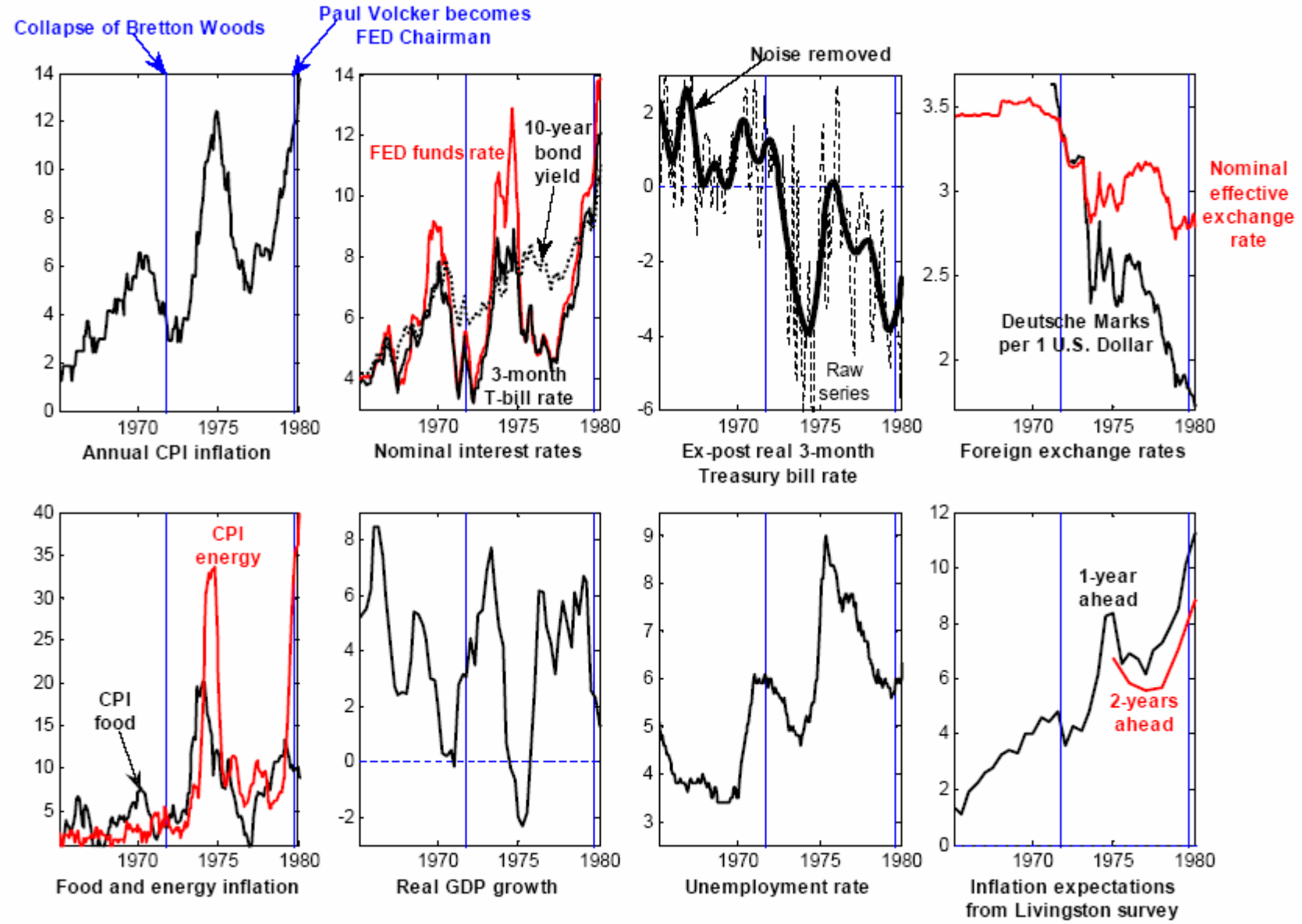

Figure 2.1 United States, January 1965-December 1979, selected macroeconomic data

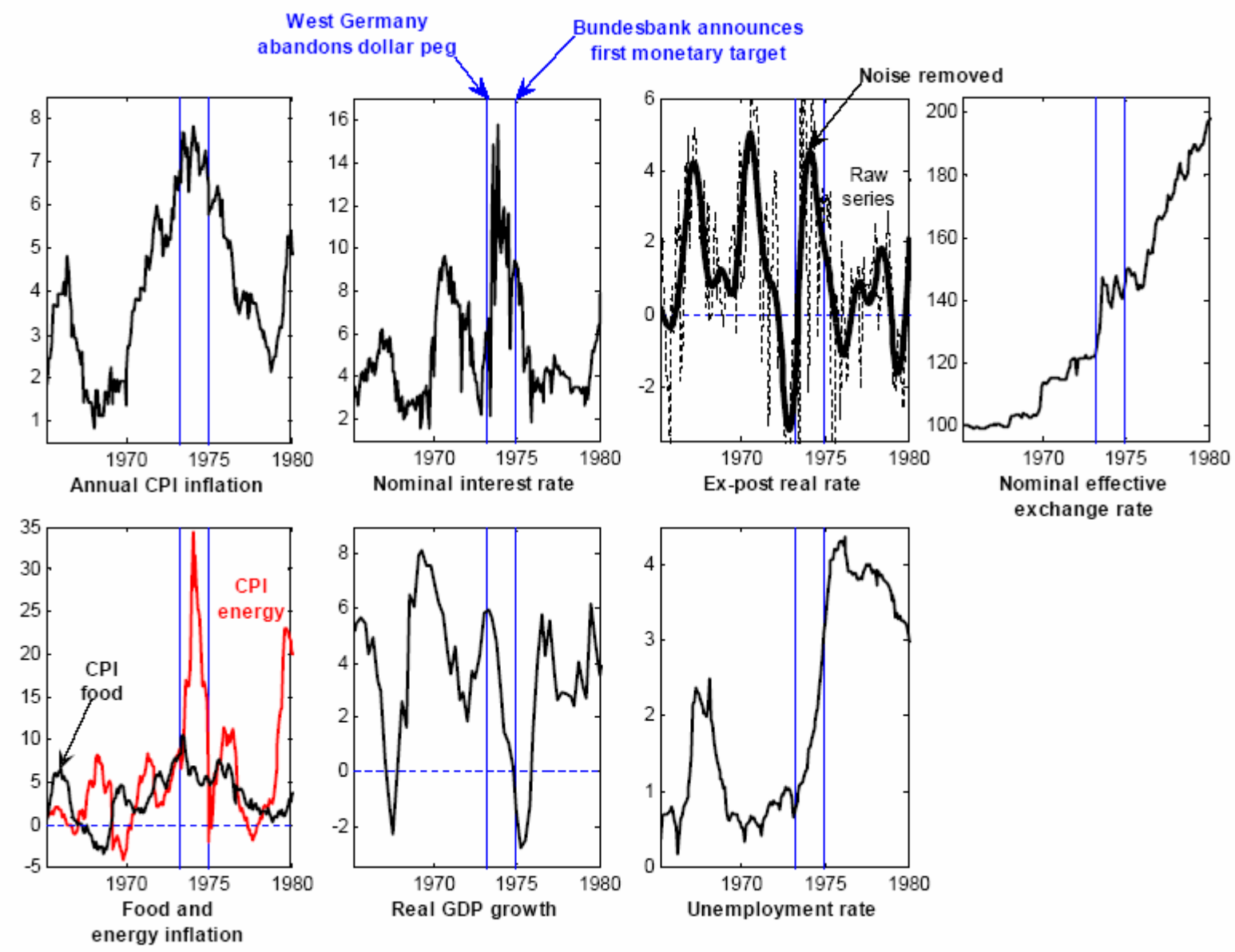

Figure 2.2 West Germany, January 1965-December 1979, selected macroeconomic data

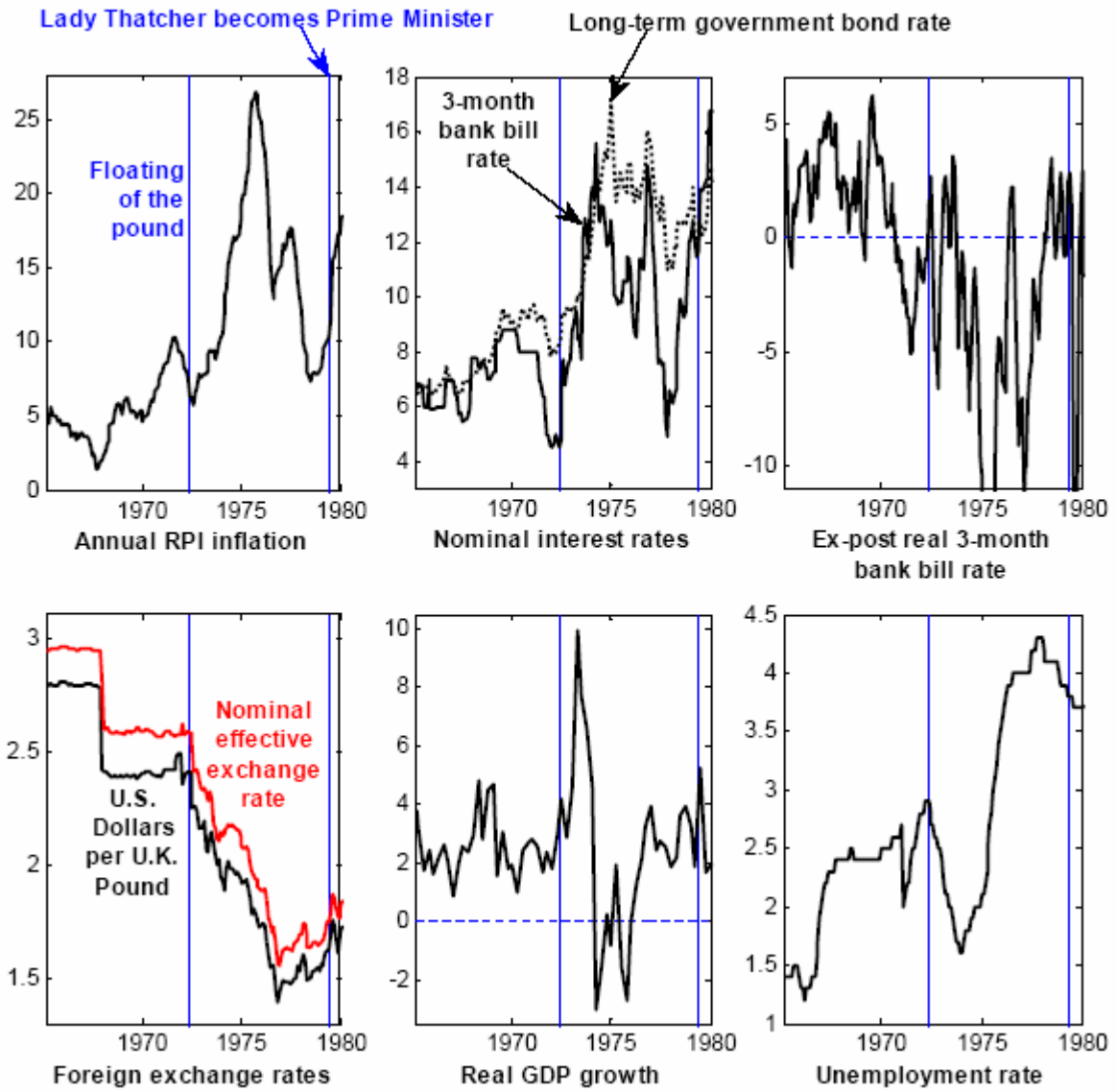

Figure 3.1 United Kingdom, January 1965-December 1979, selected macroeconomic data

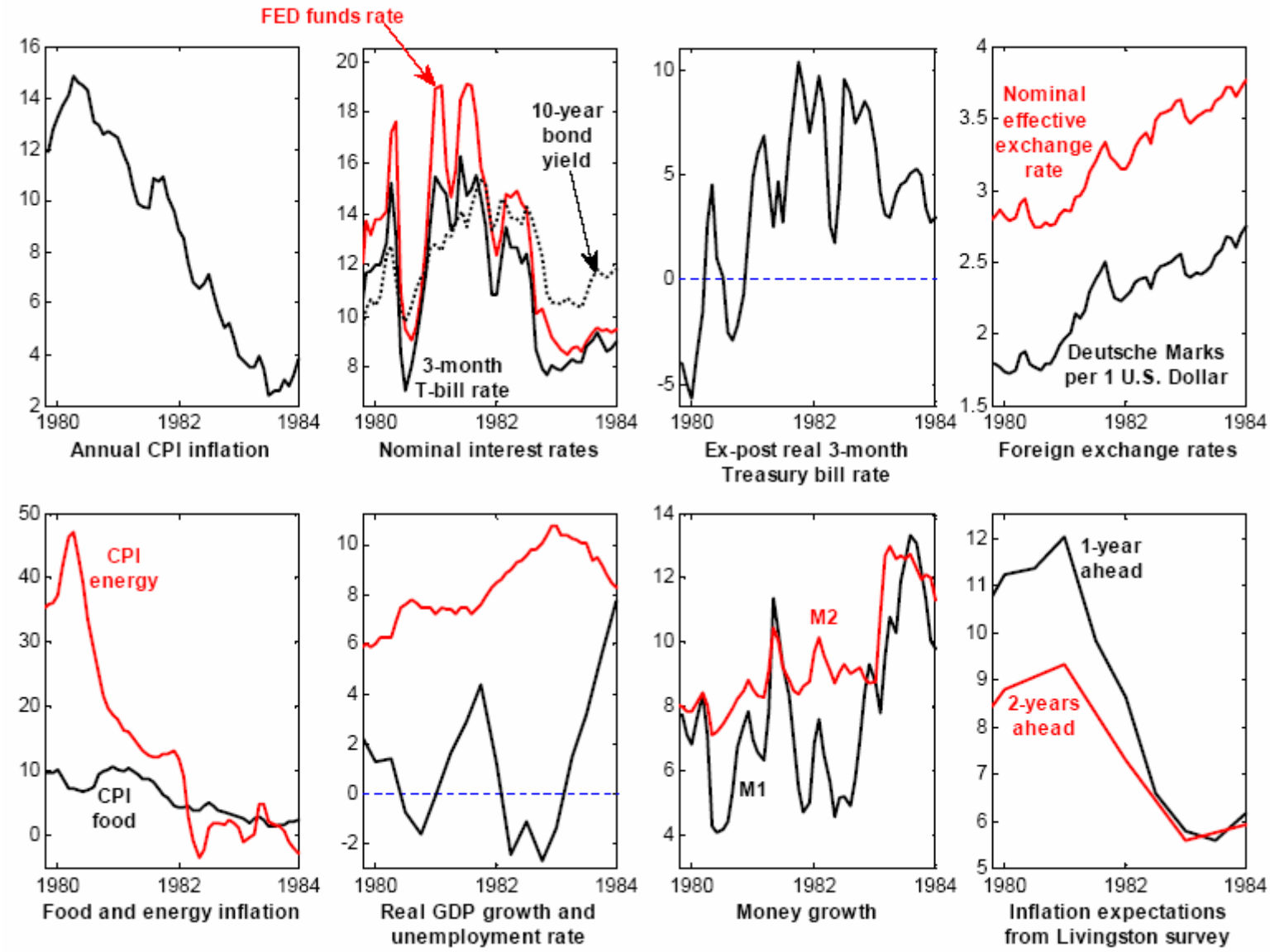

Figure 3.2 The Volcker disinflation: United States, October 1979-December 1983, selected macroeconomic data

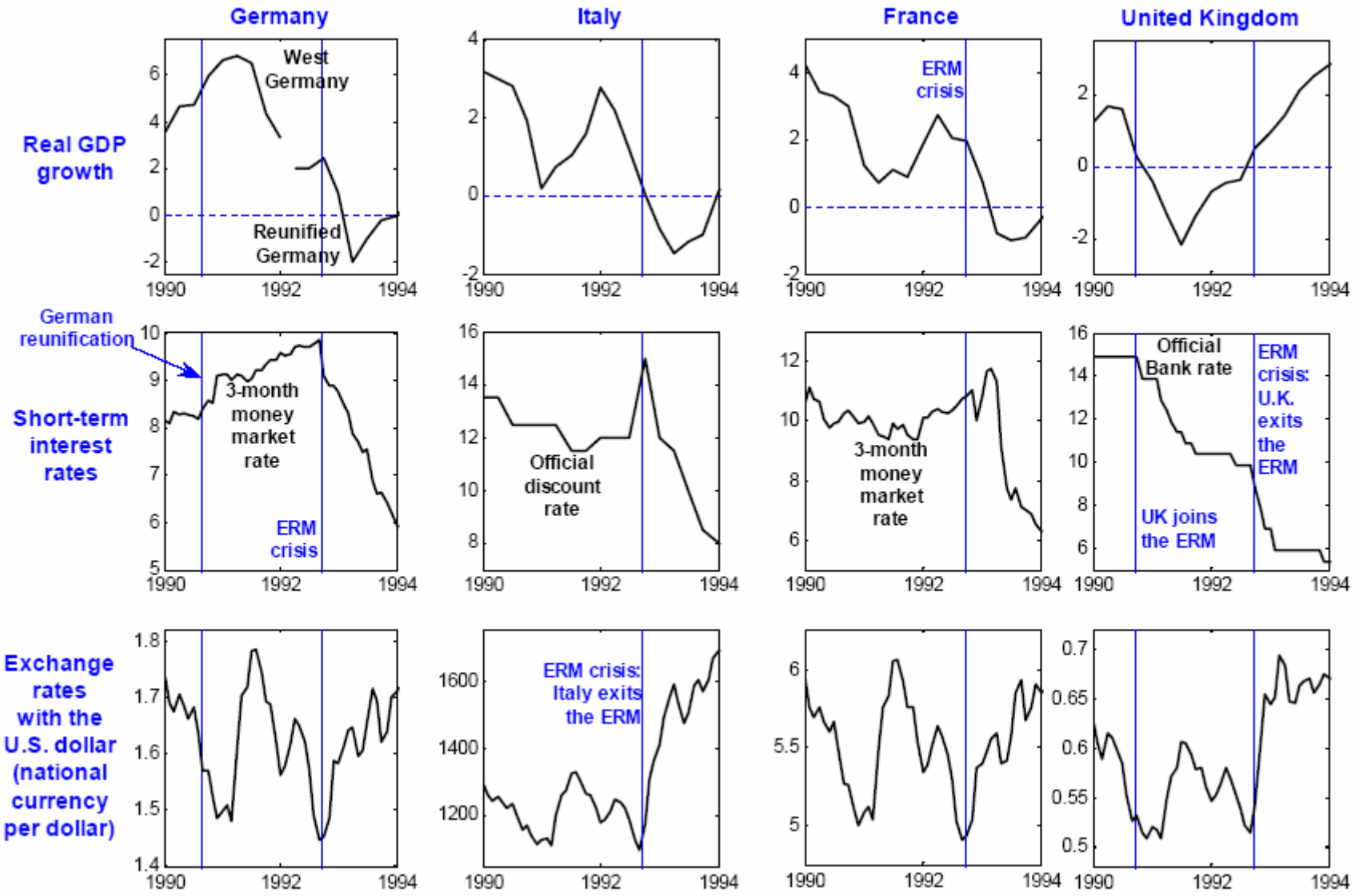

Figure 3.3 Selected macroeconomic data for Germany, Italy, France, and the United Kingdom, 1989Q4–1993Q4

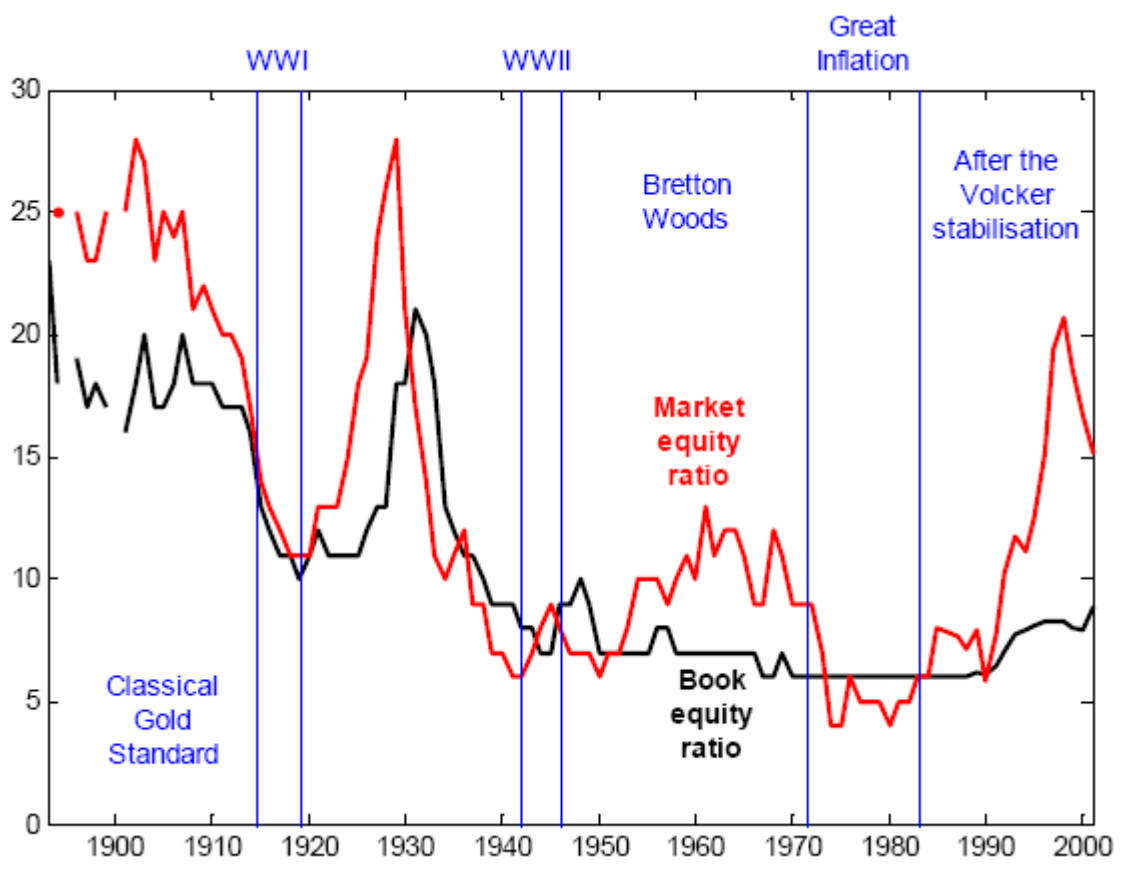

Figure 3.4 Capital ratio for U.S. banks: market and book equity ratios for U.S. banks, 1893-2001 (source: Flannery and Rangan, 2008) [to be updated if possible: talk again to Mark Flannery]

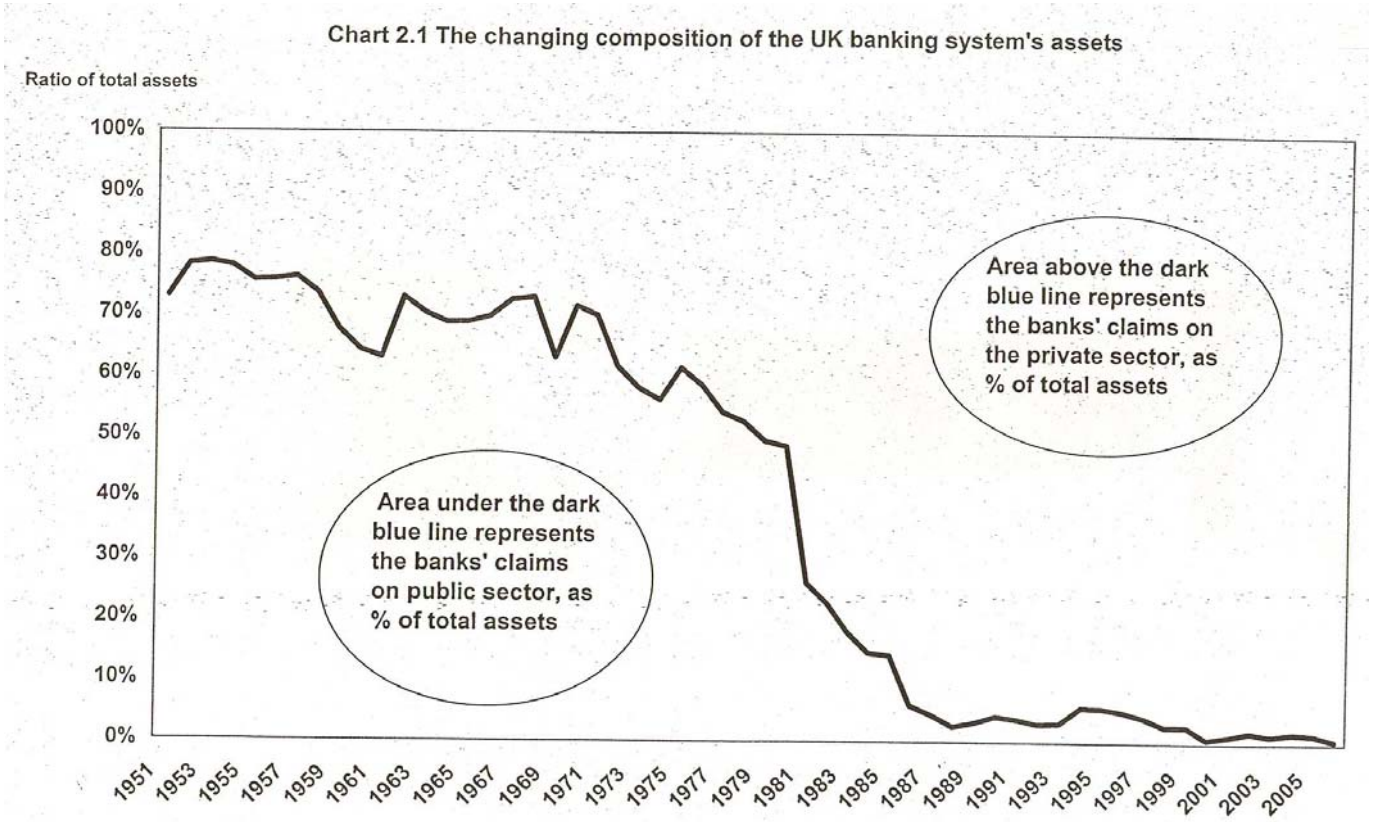

Figure 3.5 The changing composition of the U.K. banking system's, assets

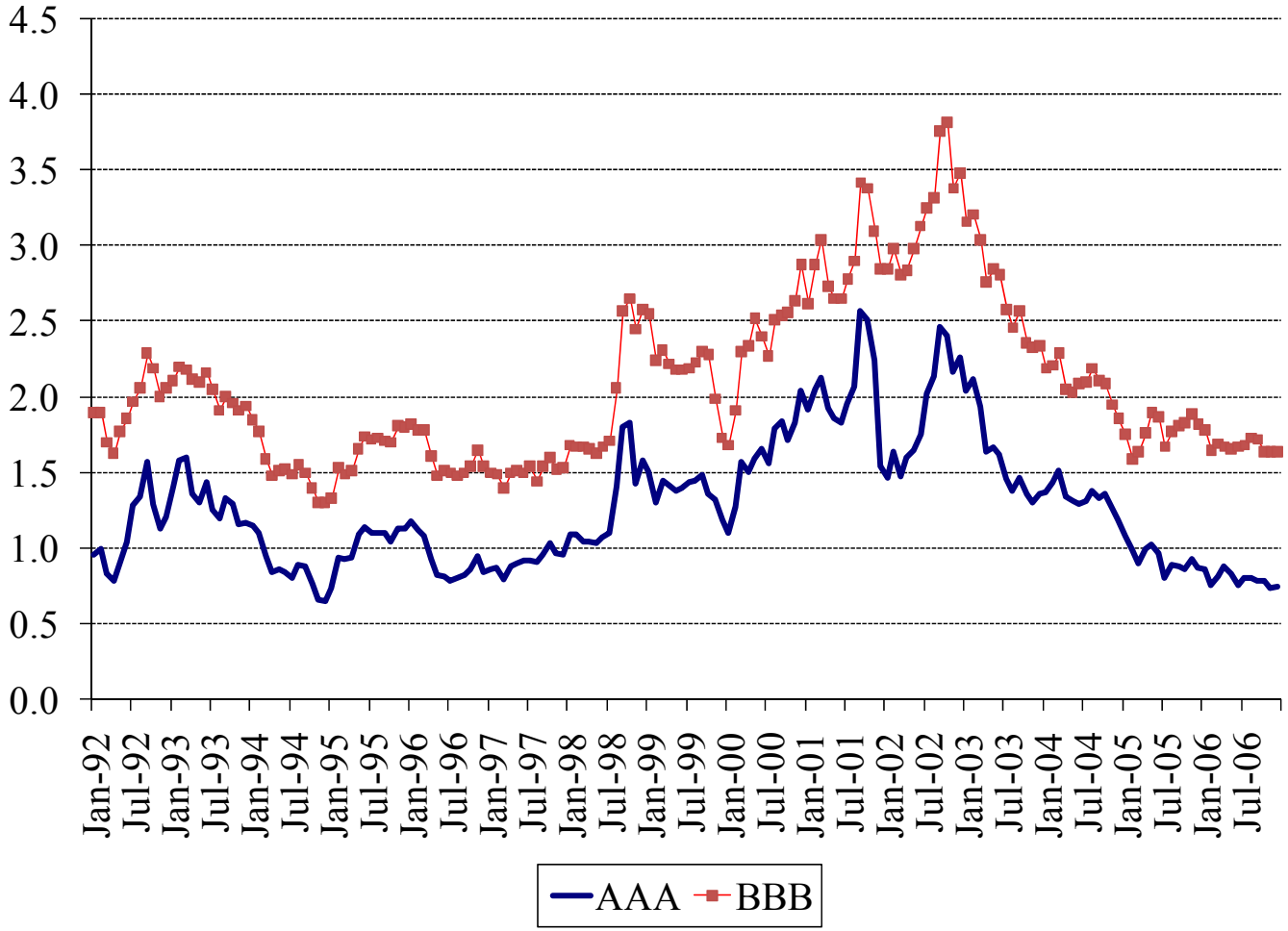

Figure 3.6 Spreads on US investment-grade corporate bond indices: difference between yields on AAA and BBB corporate bond indices and ten-year U.S. Treasury bonds

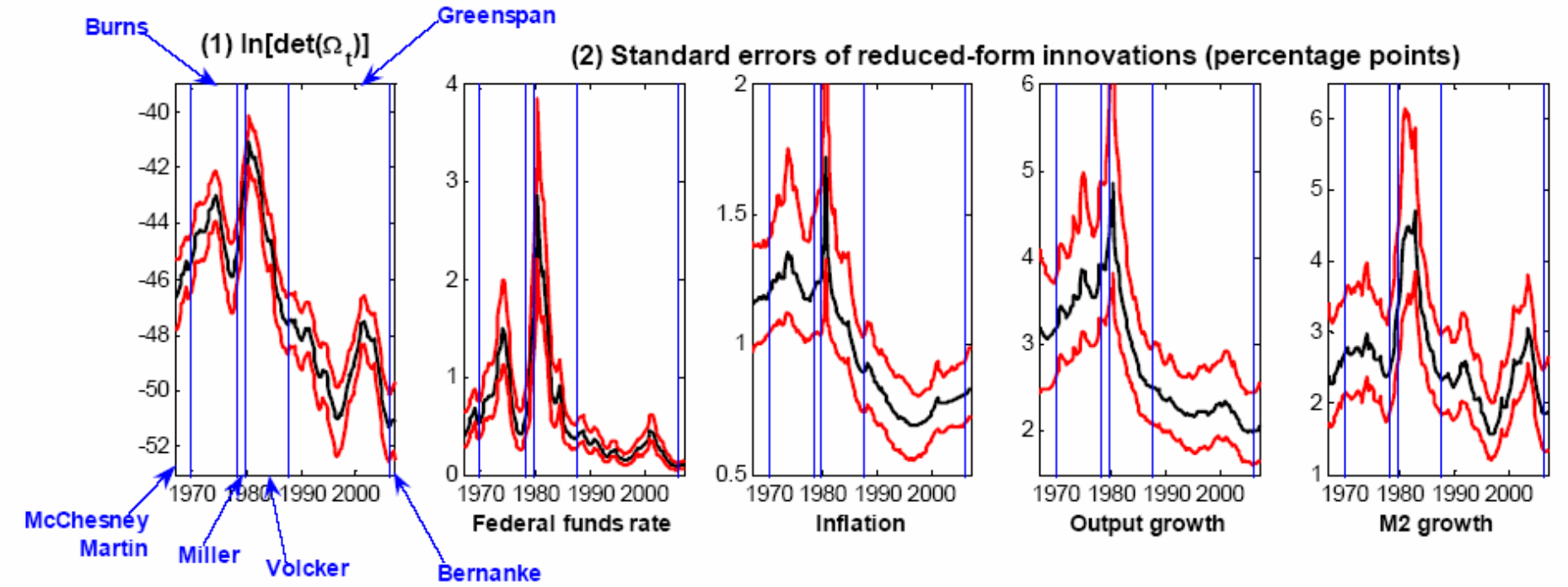

Figure 4.1 The evolution of Ω_t: $\ln|\Omega_t|$, and standard errors of reduced-form VAR innovations (in percentage points), medians and 16th and 84th percentiles

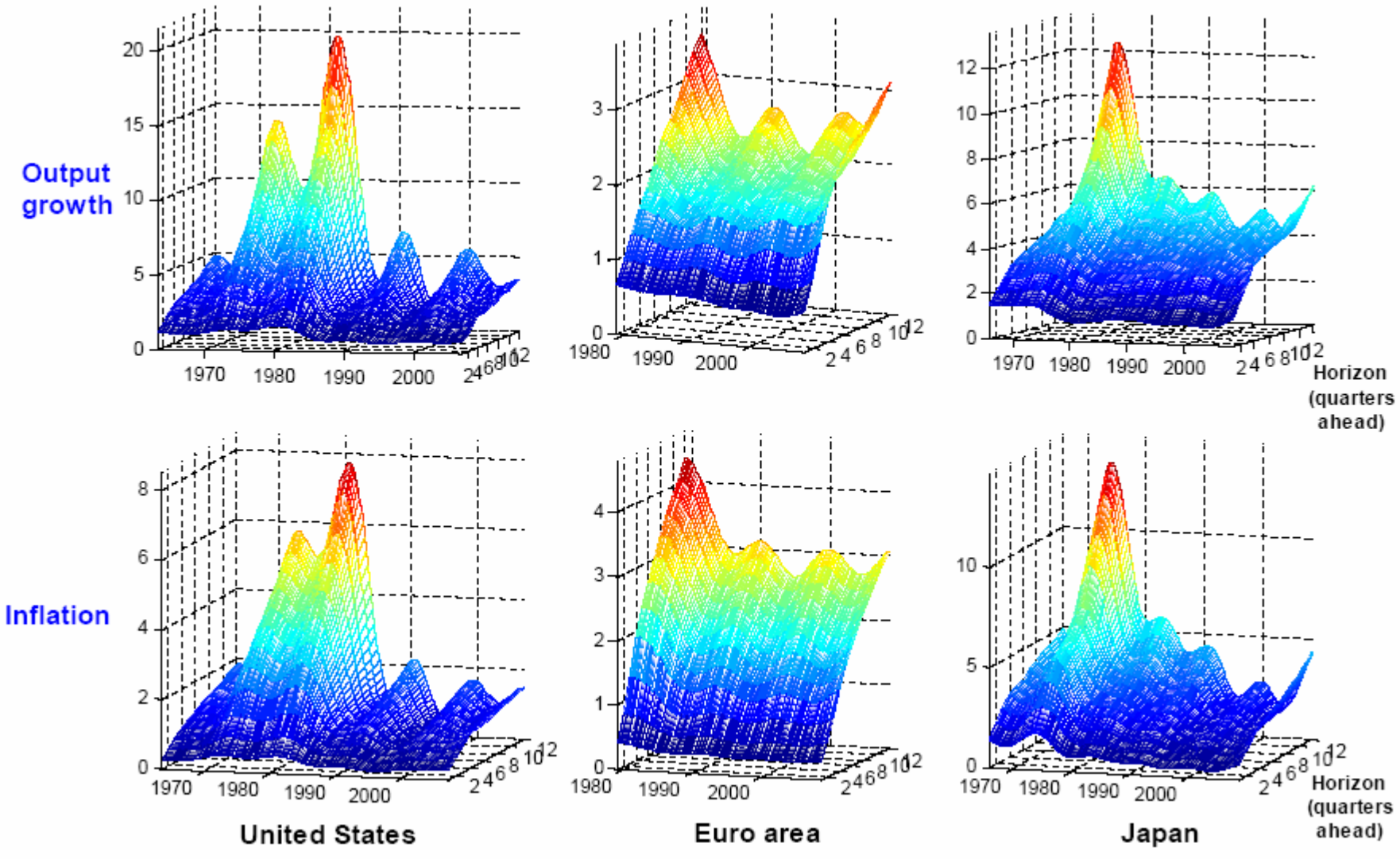

Figure 4.2 Evolving macroeconomic uncertainty: standard deviations (in percentage points) of k-step ahead projections

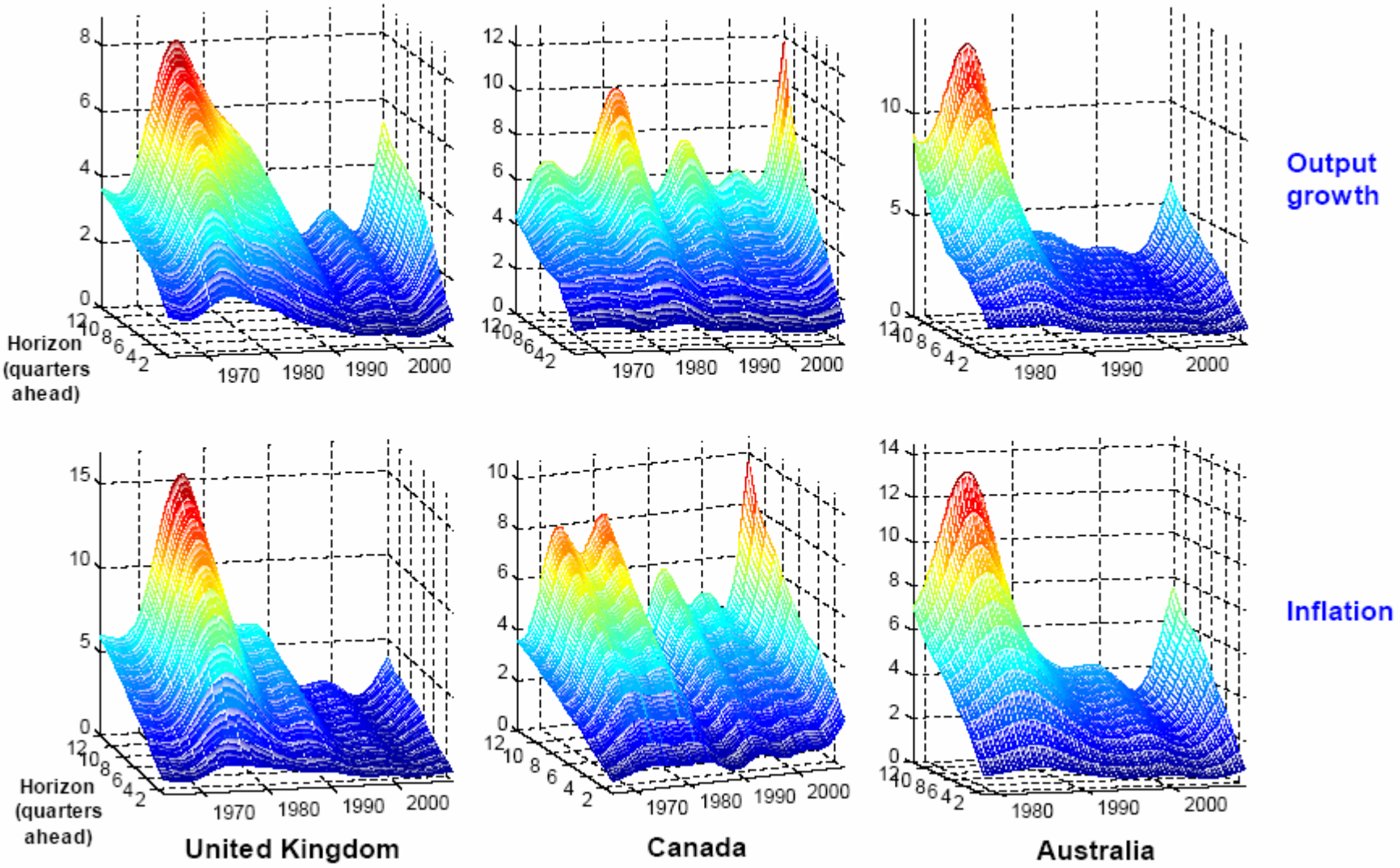

Figure 4.2 (continued) Evolving macroeconomic uncertainty: standard deviations (in percentage points) of *k*-step ahead projections

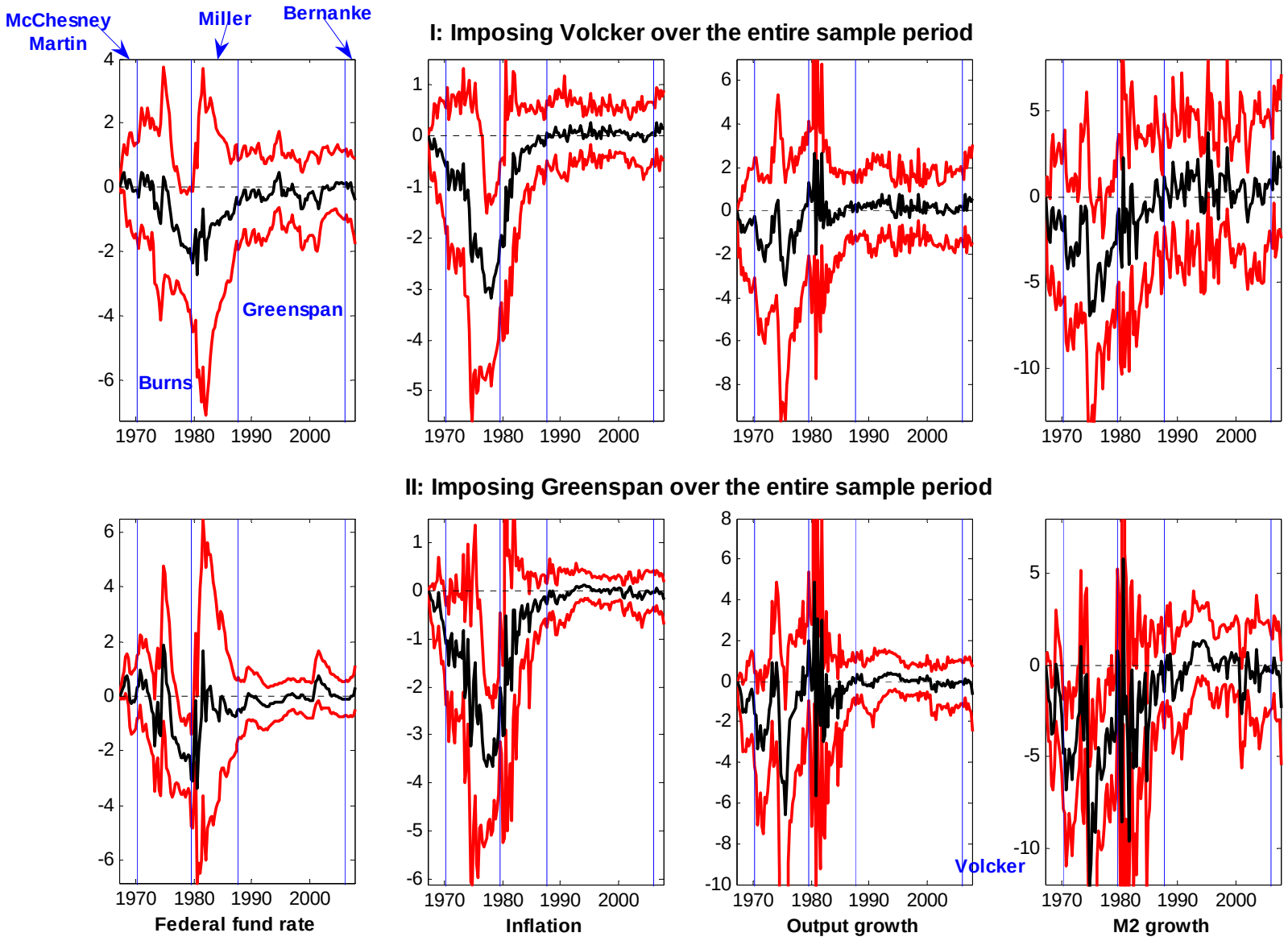

Figure 4.3 Imposing Paul Volcker and Alan Greenspan over the entire sample period: counterfactual minus actual, median of the distributions and 16th and 84th percentiles

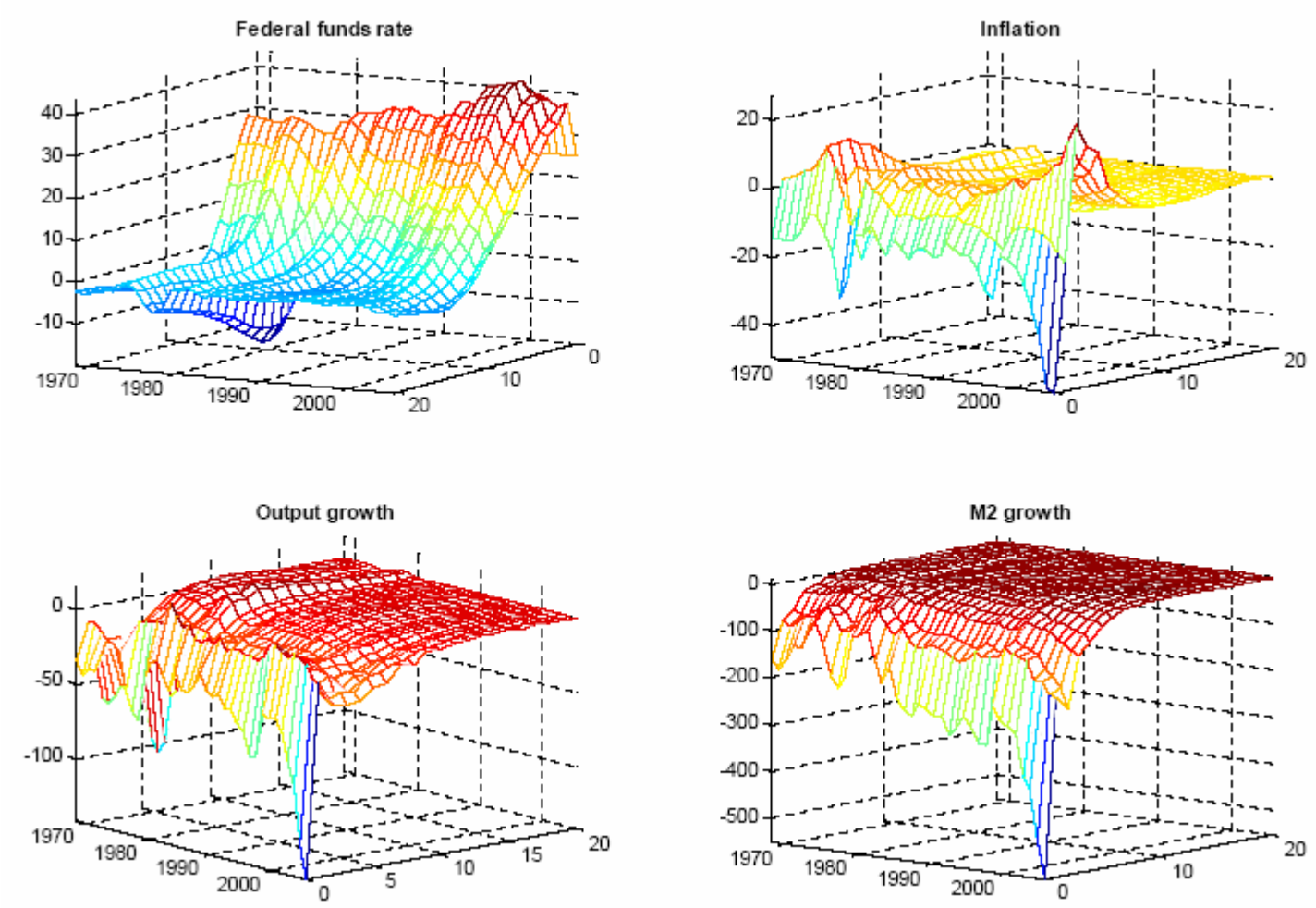

Figure 4.4 Time-varying median impulse-response functions to a monetary policy shock (basis points)

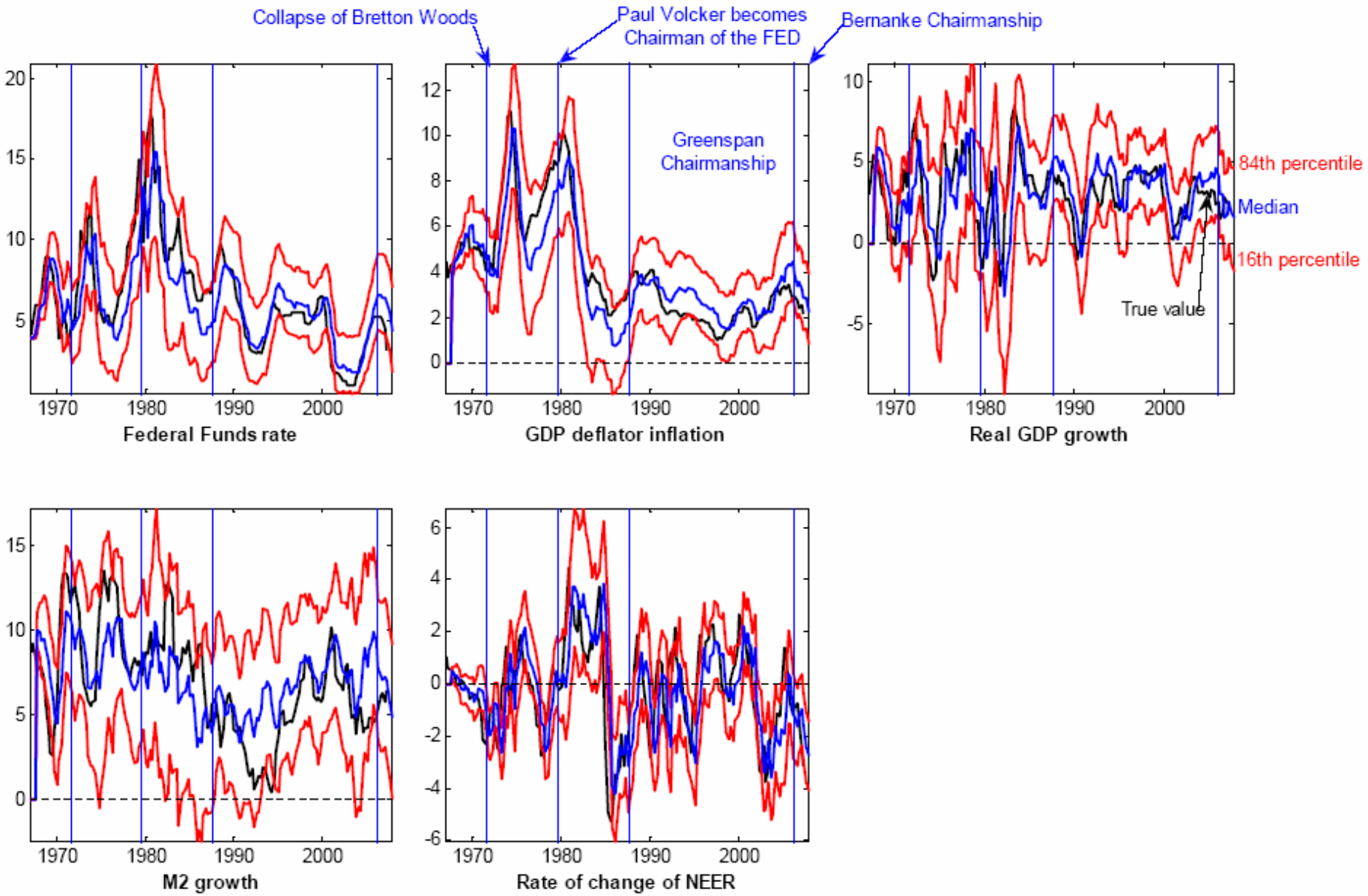

Figure 4.5 Bringing the *Bundesbank* to the United States: results from counterfactual simulations based on the five-variables VAR (medians and 16th and 84th percentiles), together with the actual series

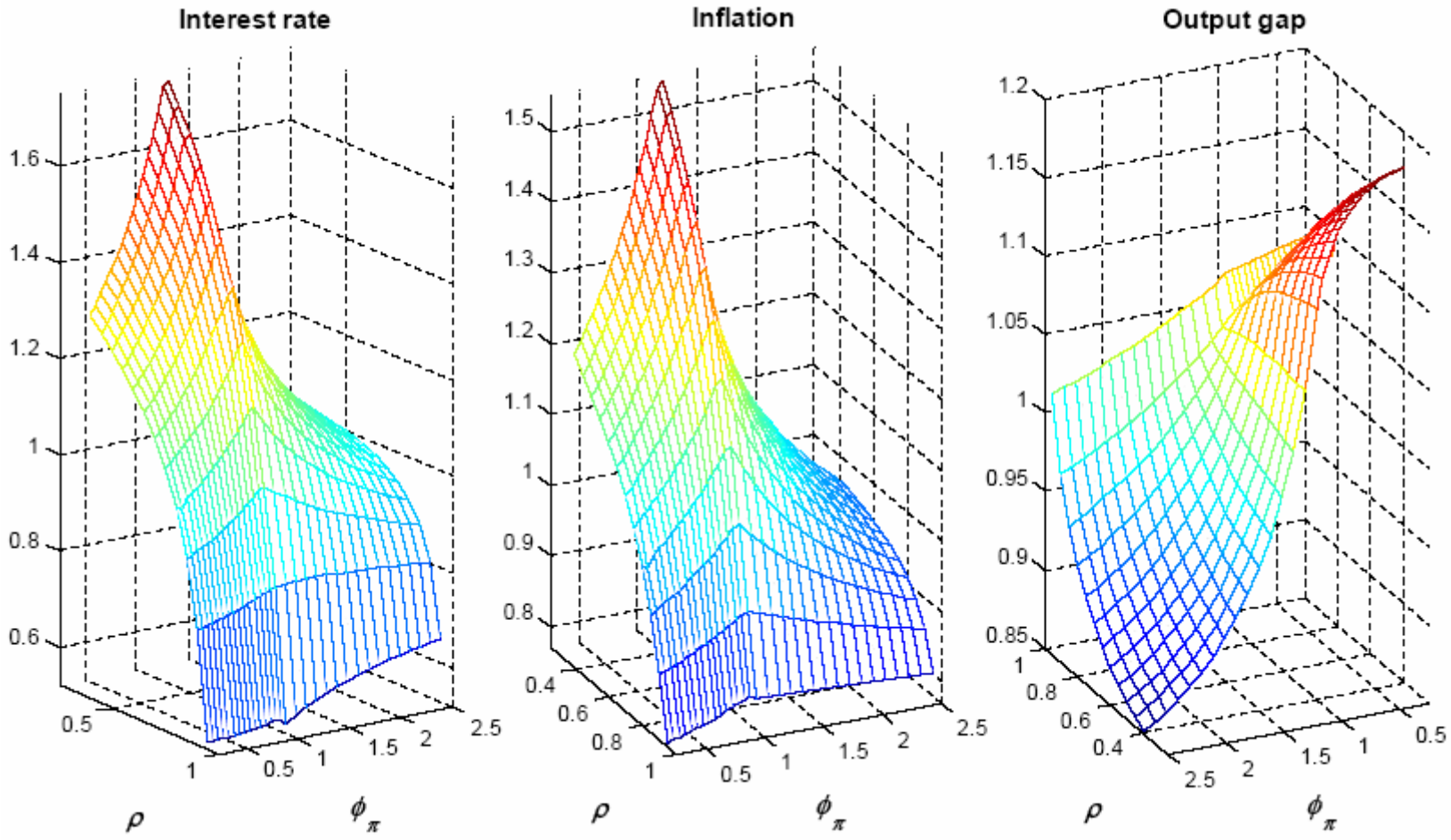

Figure 4.6 Ratios between the series' theoretical standard deviations from the SVAR-based policy counterfactual and the series' benchmark standard deviations

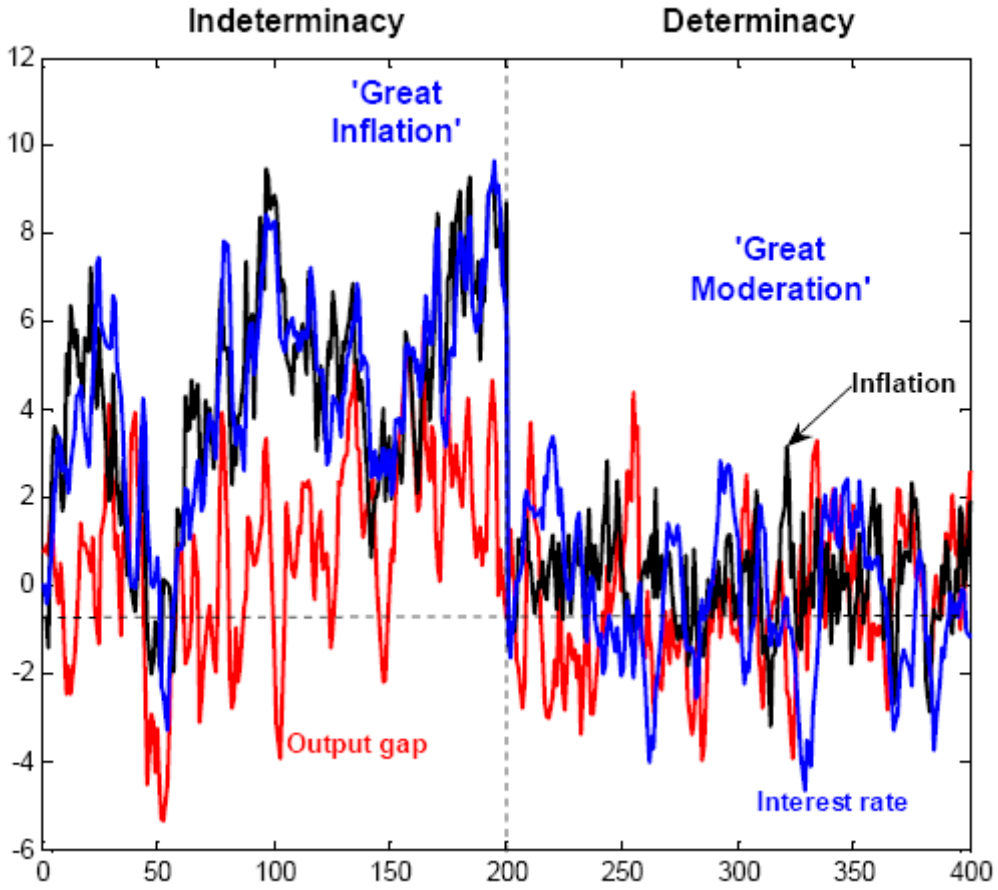

Figure 4.7 Replicating the Great Moderation: a simple illustration of Clarida *et al.*'s (2000) 'indeterminacy hypothesis'

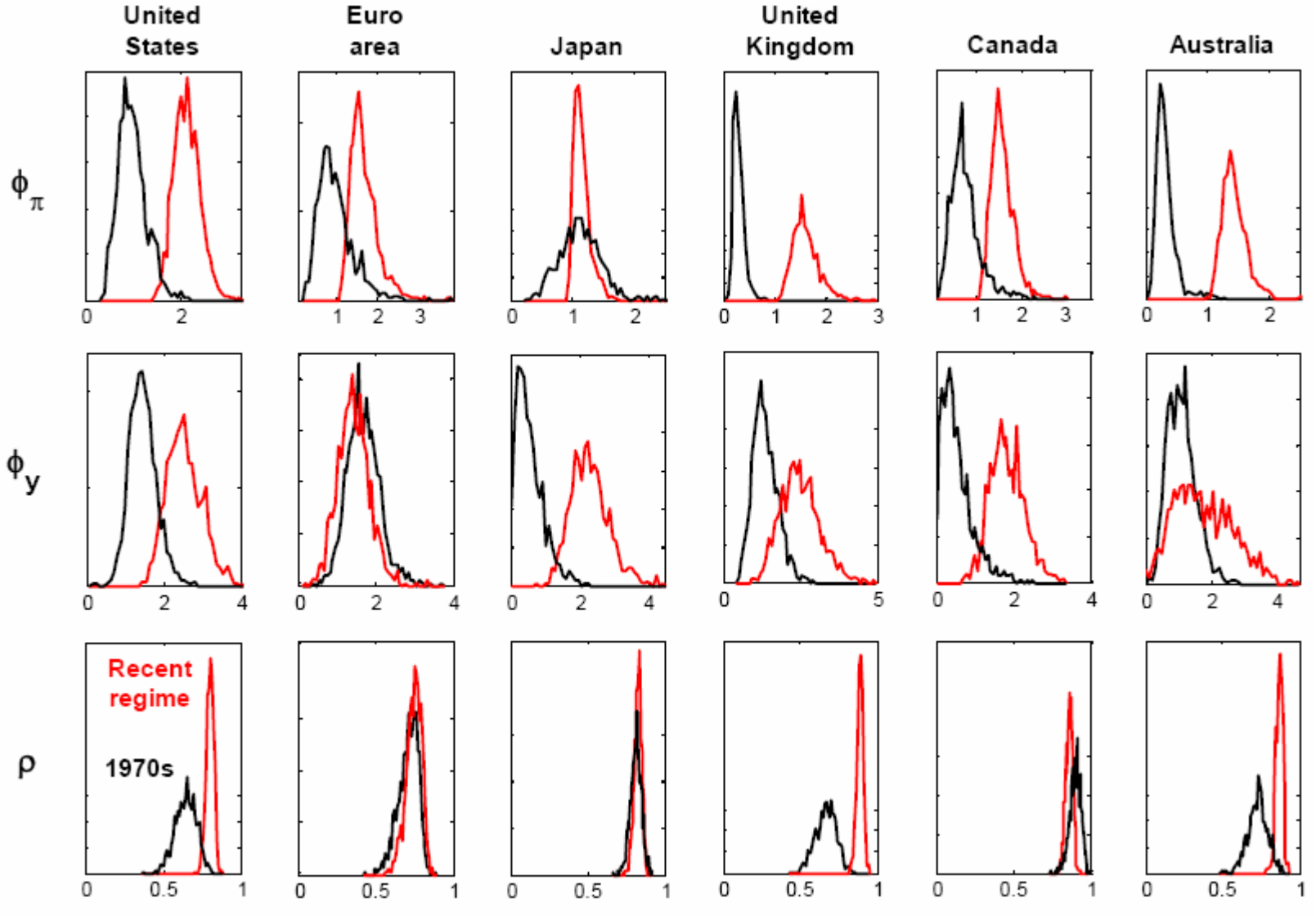

Figure 4.8 The evolution of the monetary policy stance: posterior distributions for the Taylor rule coefficients for the 1970s and the more recent regimes/periods

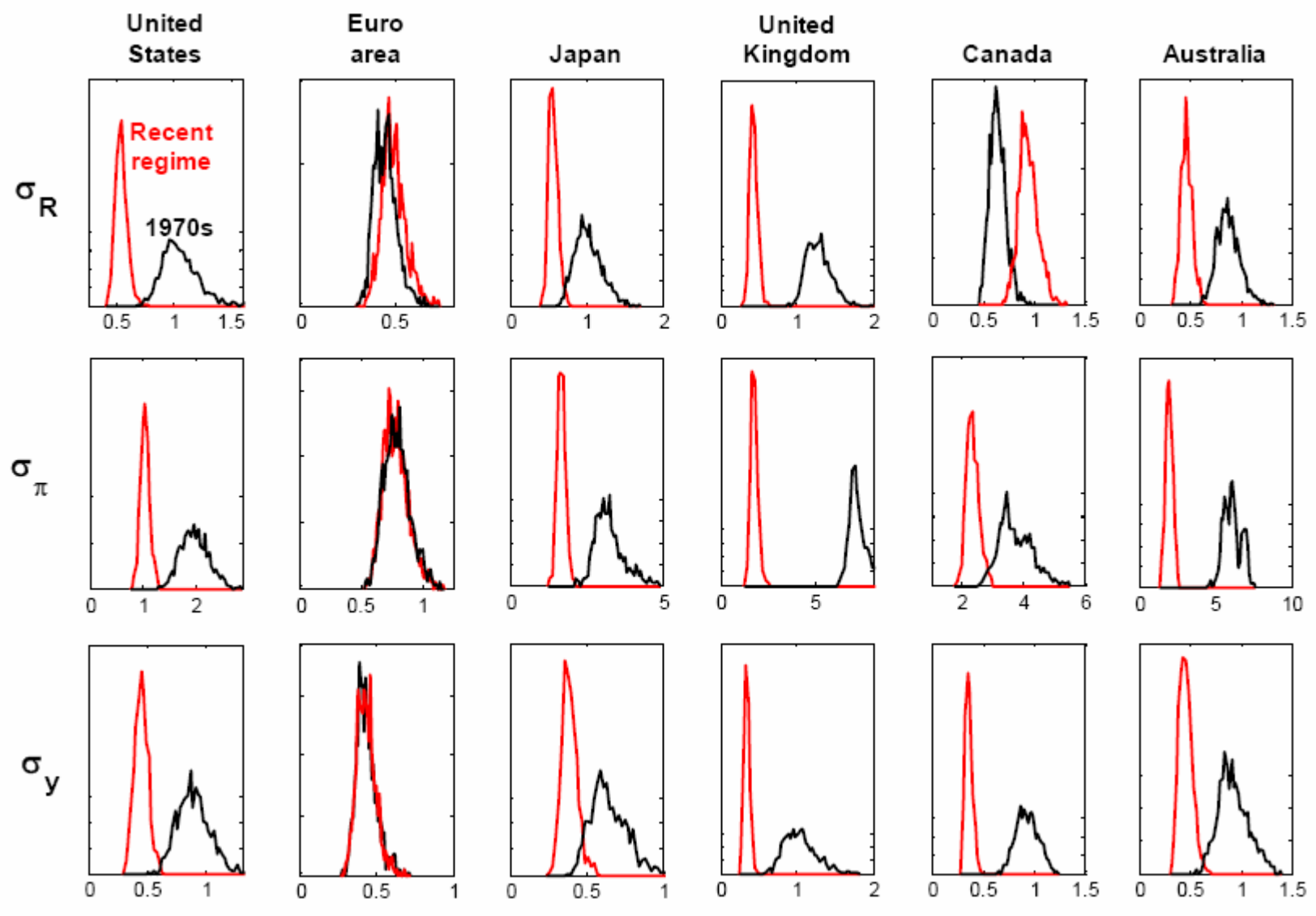

Figure 4.9 The evolution of the volatilities of the structural shocks: posterior distributions of the standard deviations for the 1970s and the more recent regimes/periods

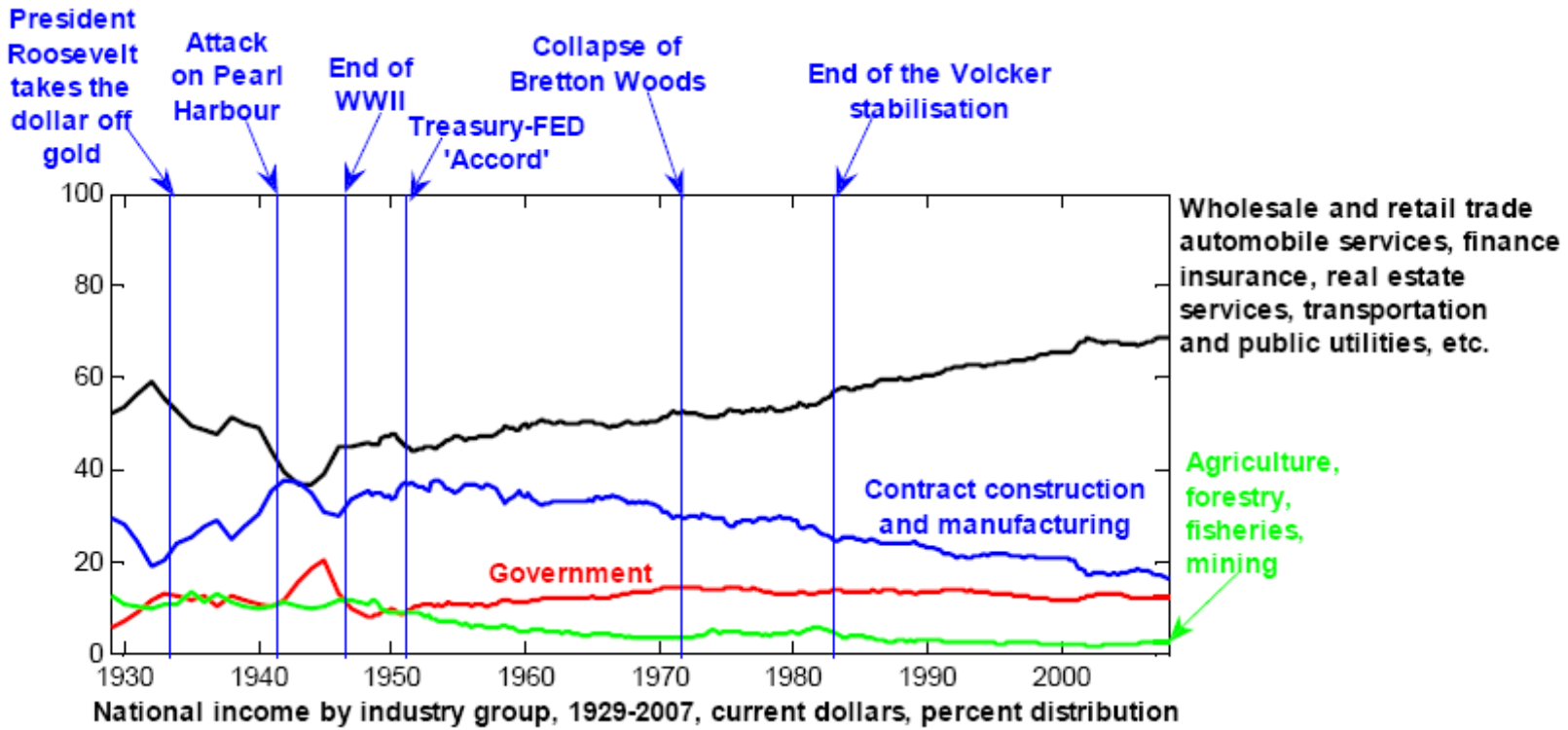

Figure 4.10 The structural transformation of the U.S. economy, 1929-2007: national income by industry group (source: *U.S. Department of Commerce*, *Bureau of Economic Analysis*, National Income and Product Accounts, Tables 6.1A, B, C, and D)

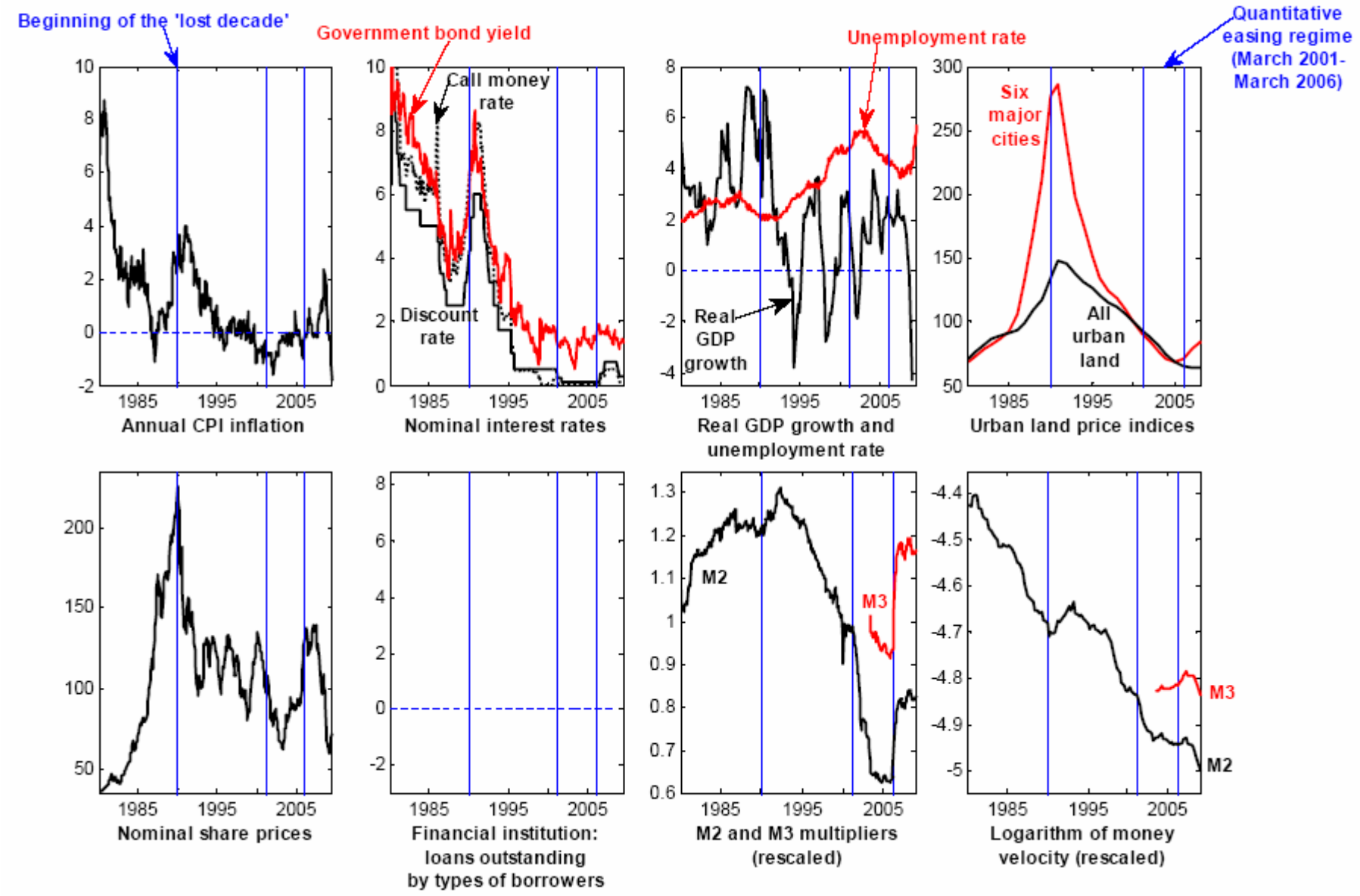

Figure 4.11 Japan, selected macroeconomic data, 1980-2009 [finish with loans by type of borrower]

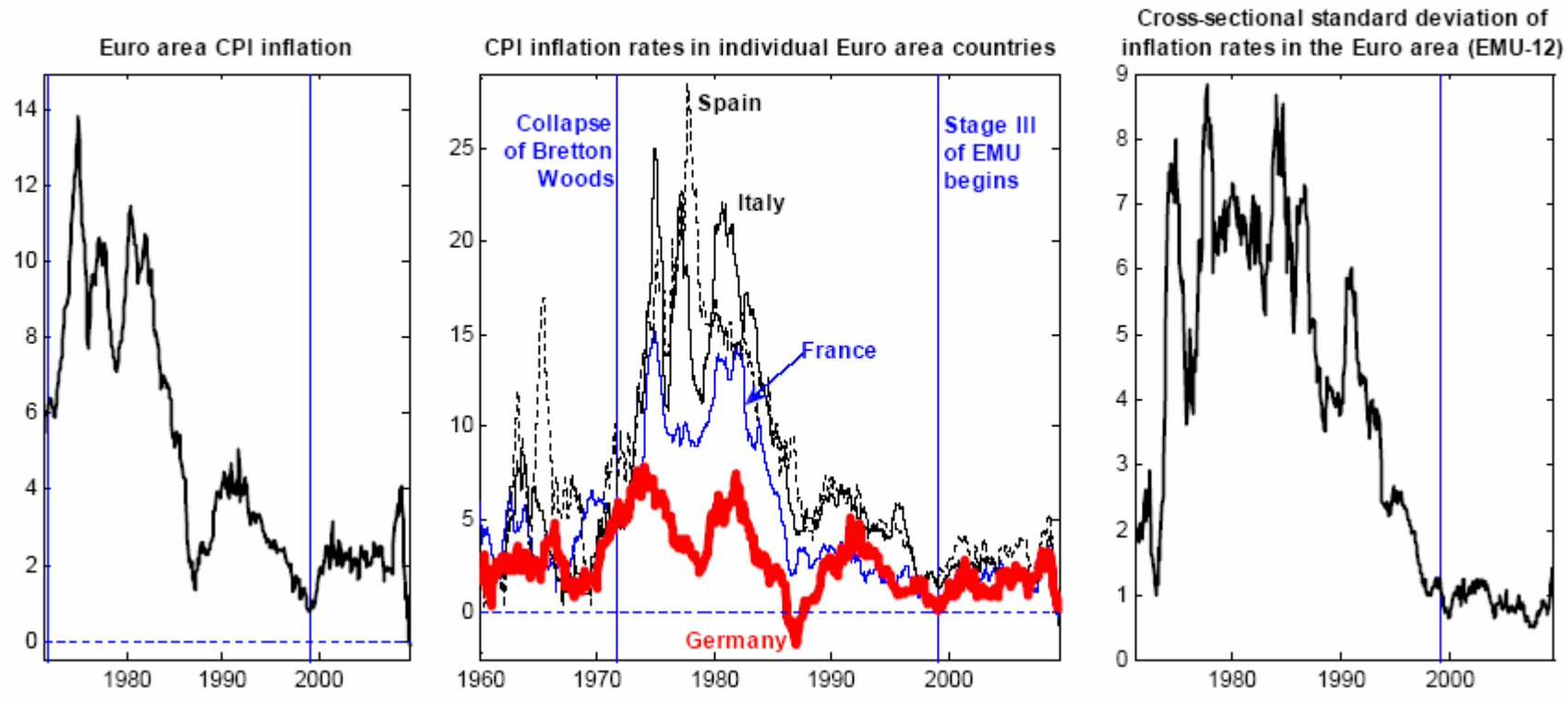

Figure 4.12 From the Great Inflation to European Monetary Union: inflation, and cross-sectional standard deviation of inflation rates in the Euro area's constituent countries

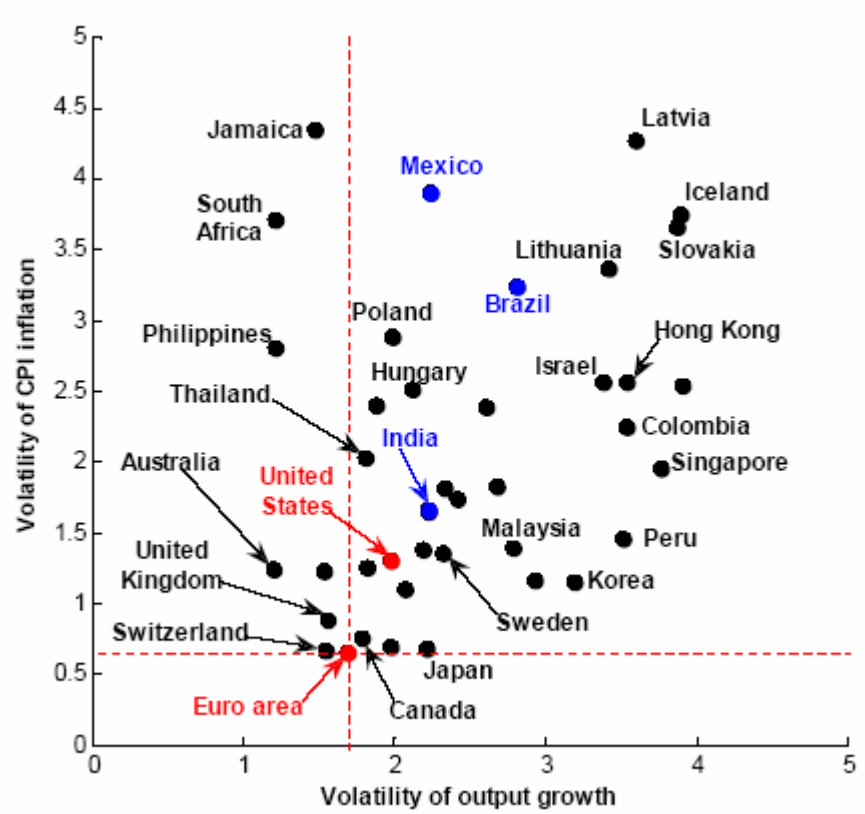

Figure 4.13 The Euro area's comparative macroeconomic performance under European Monetary Union: standard deviations of annual CPI inflation and annual output growth since January 1999 in the Euro area and selected countries

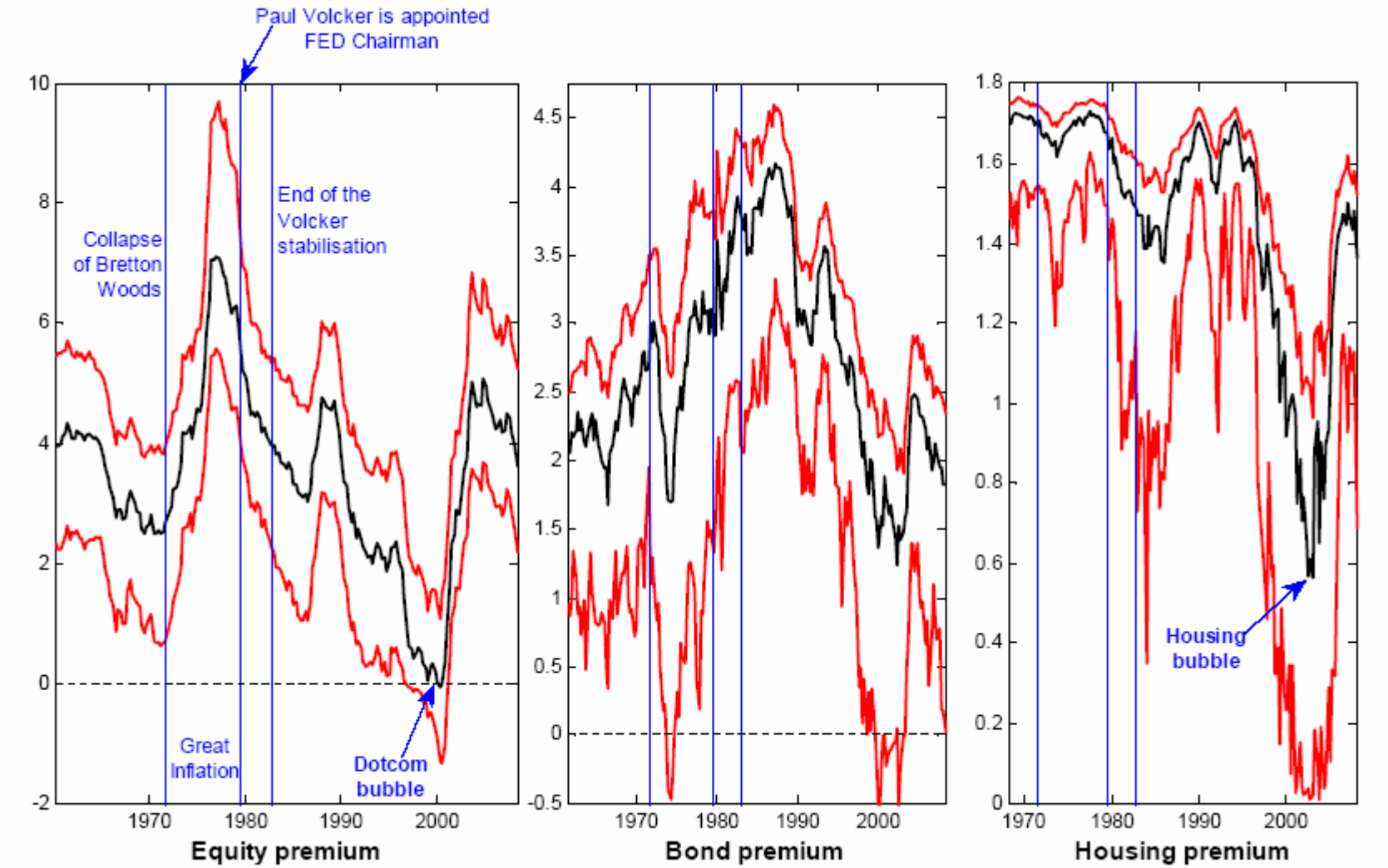

Figure 4.14 Time-varying U.S. equity, bond, and housing risk premia, median estimates and 16th and 84th percentiles

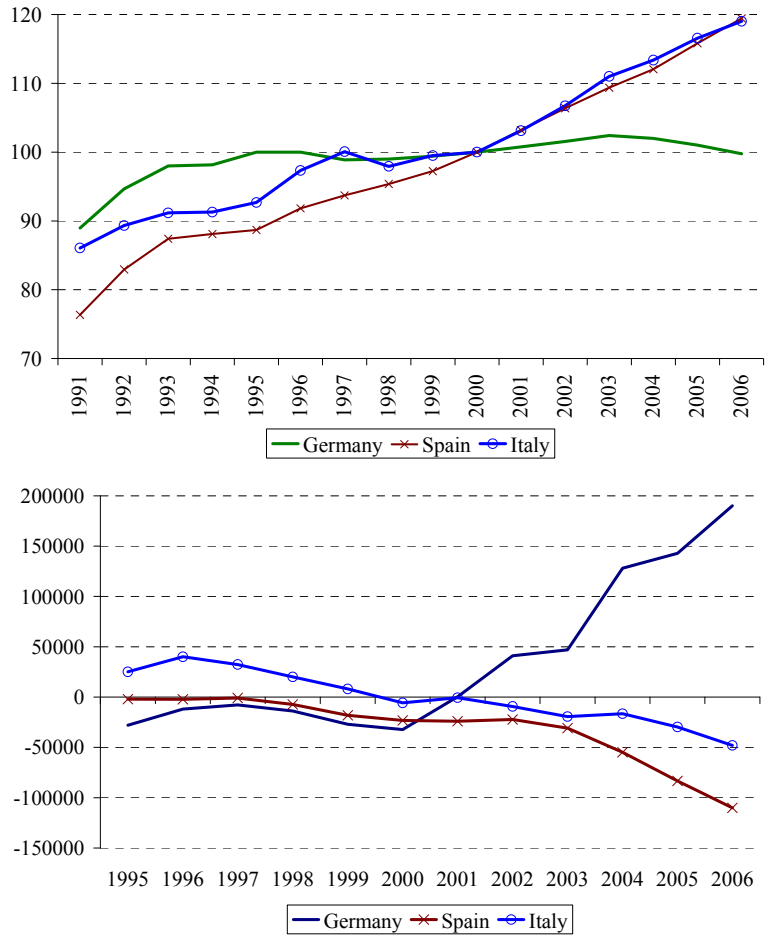

Figure 4.15 Germany, Italy, Spain: current account and unit labour costs

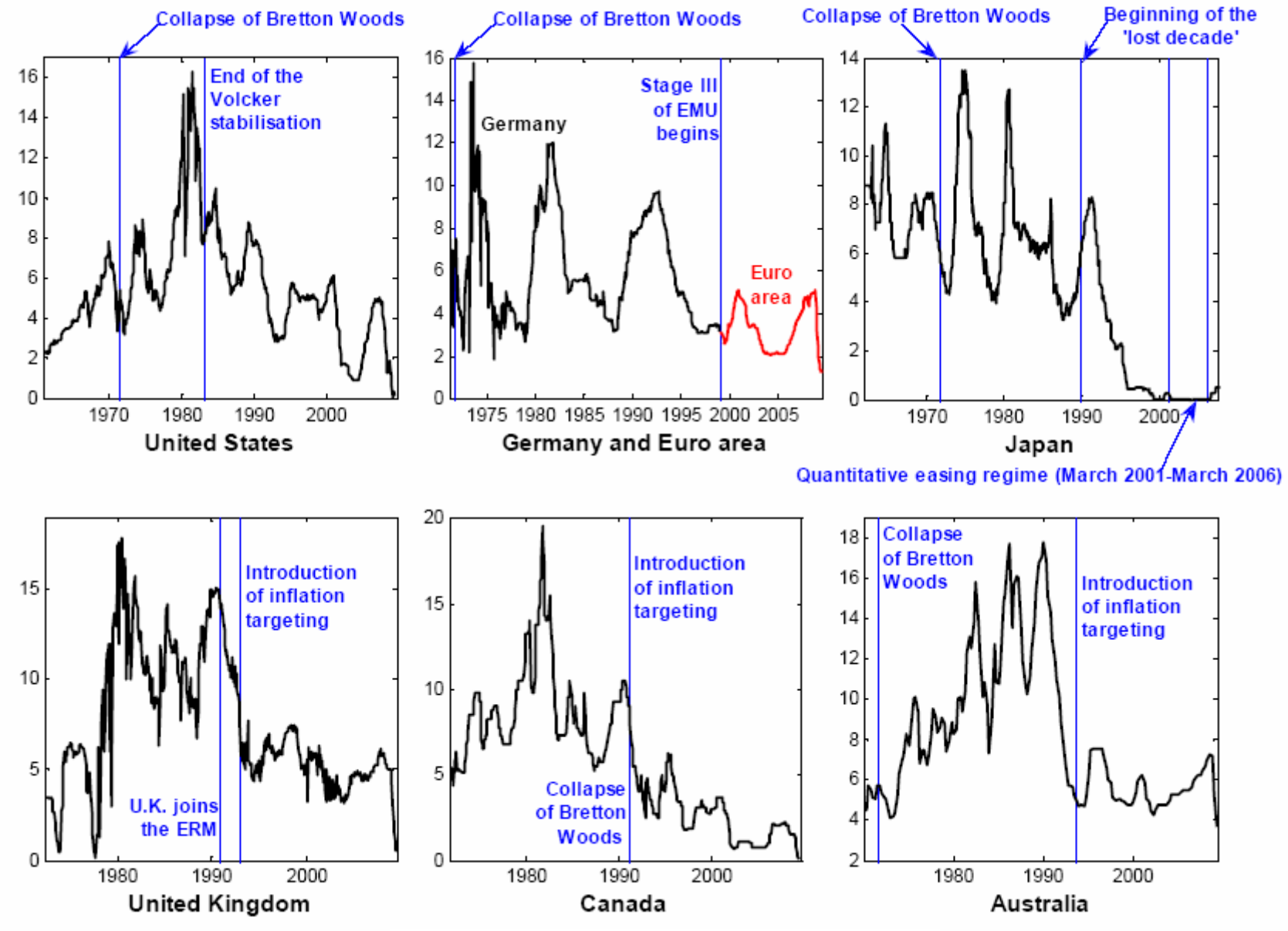

Figure 5.1 Short-term nominal interest rates

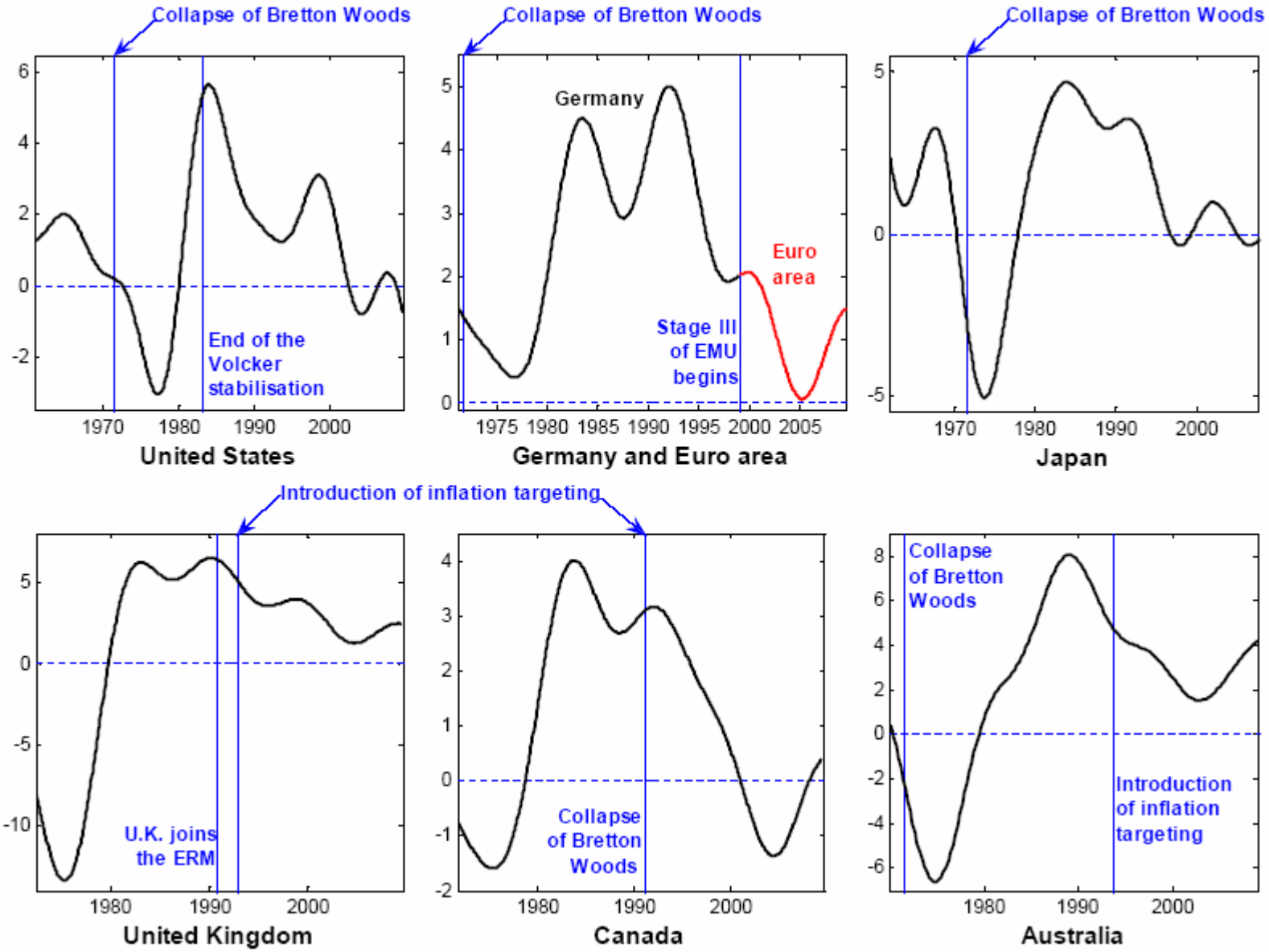

Figure 5.2 The simplest measure of changes in the monetary policy stance: the evolution of the *ex post* real rate (filtered components with frequencies of oscillation beyond three years)